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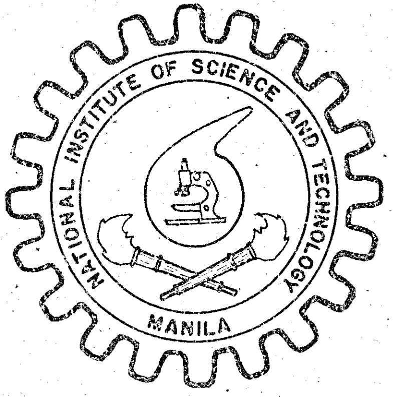
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DEMANIA ALCALAI, A SECOND NEW SPECIES OF POISONOUS CRAB FROM THE PHILIPPINES (CRUSTACEA, DECAPODA, BRACHYURA)*

By John S. Garth
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ABSTRACT

A second species of the xanthid crab genus *Demania* is reported from the Philippines with the description and illustration of *D. alcalai,* new species, from Negros Oriental in shallow water. The new species is compared with other members of the genus from Singapore and Ceylon. As with the earlier described *D. toxica* Garth,1) this second Philippine species is also known to be poisonous.

INTRODUCTION

In July, 1971, the writer received from the Research Center of Silliman University, Dumaguete City, Philippines, a large xanthid crab caught by gill net in shallow water off Siaton Town, Negros Oriental. Although several parts of this crab were unfortunately missing, the carapace and chelipeds were intact, and on this basis the specimen was assigned to *Demania toxica* Garth,1) the description of which was in progress. A note inserted in proof as an addendum to the description gave measurements of this male, but no other particulars.

Two additional specimens collected in October, 1973, reached the writer subsequently: an intact female in December, 1973, and

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*Allan Hancock Foundation Contribution No. 354.

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a male in July, 1974, which, although lacking maxillipeds, retained the abdomen and pleopods that were missing from the male received three years earlier. By this time it was apparent that these three specimens represented a second species of *Demania* from the Philippines, also new to science, and that the earlier assignment of the large male to *D. toxica* was an error. That this species was also poisonous was demonstrated by the work of Professor A. C. Alcala of Silliman University and his associate, Miss Esther E. Carumbana. Dr. Alcala will report independently on the results of his toxicological studies; it suffices here to note that the same three specimens have served in double capacity: their soft parts for biological assay and their hard parts for taxonomic description.

Acknowledgment is made to Professor Alcala for permission to describe the new species and to retain the holotype and paratypes in the Allan Hancock Foundation (A.H.F.), to Miss E. E. Carumbana for supplying relevant data, and to Dr. R. Serène, former UNESCO marine science regional expert for Southeast Asia, whose manuscript key to *Demania* was used in this study. Illustrations by Mr. Jerry J. Battagliotti were made possible by a subvention from the Research and Publication Fund of the University of Southern California.

DEMANIA ALCALAI sp. nov. Figs. 1-6.

Demania toxica Garth (1971) 183 (part: the 75 by 94 mm male only).

Type. – Holotype female, A.H.F. No. 731, from off Bantayan Barrio, Dumaguete City, Negros Oriental, Philippines; October 10, 1973; caught in bamboo fish trap in 3 feet of water; Jesus Cimafranca, collector. Paratype male, from Piapi, Dumaguete City, Negros Oriental; October 10, 1973; coral reef, 3 feet; Calixto Cimafranca, collector. Paratype male, from off Siaton Town, Negros Oriental; June, 1971; caught in gill net; collector unknown. Specimens received from A. C. Alcala, Silliman University, Dumaguete City, Negros Oriental, Philippines.

Measurements. – Female holotype, length of carapace 58.5 mm, width of carapace 74.1 mm, of front 16.6 mm, of fronto-orbit 31.3 mm, length of chela 43.0 mm, of dactyl 22.0 mm, height of palm 21.5 mm. Male paratype, length 57.1 mm, width 72.2 mm. Male paratype, length 75 mm, width 94 mm.

Diagnosis. – Front produced, median notch narrow, lobes concave. Carapace and chelipeds largely smooth, a few squamose tubercles laterally and posteriorly. Anterolateral margins dentate,

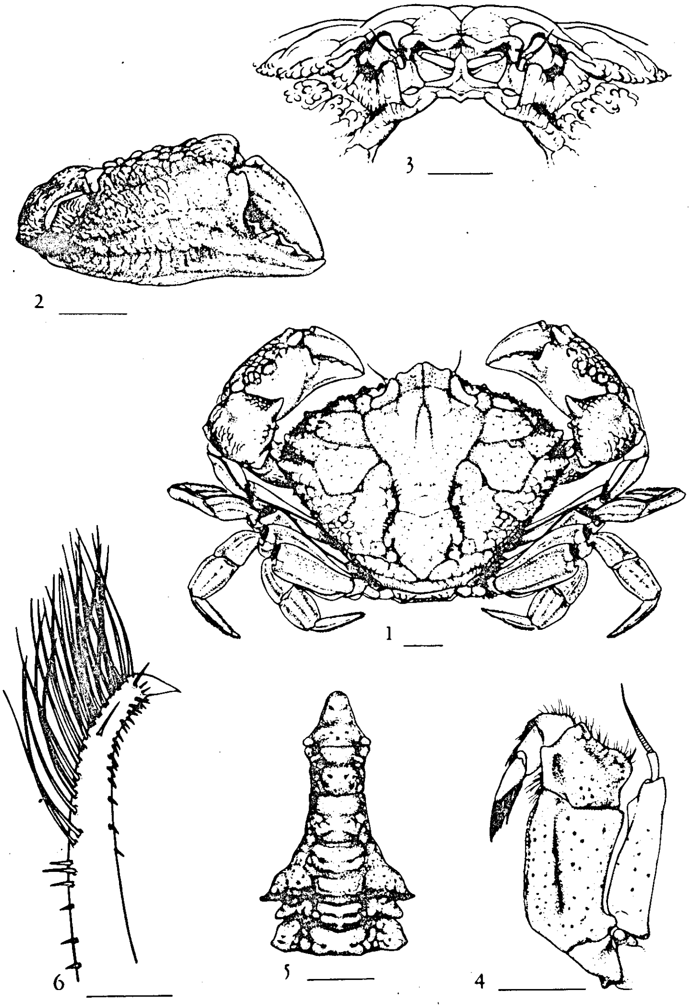

FIG. 1. *Demania alcalai* sp. nov.: Female holotype: *1*, dorsal view; *2*, right chela; *3*, frontal view; *4*, left outer maxilliped. Male paratype: *5*, abdomen; *6*, first pleopod. Scale for figs. 1-5 = 10 mm: for fig. 6 = 0.5 mm

edges denticulate. Walking legs smooth, crested above and below. Male first pleopod with a row of 23 to 24 longer setæ on convex margin.

Description. – Carapace pentagonal; front advanced, anterolateral margins arcuate, toothed, posterolateral margins straight.

Surface convex anteroposteriorly, slightly so from side to side. Regions defined by shallow grooves, areoles devoid of squamiform tubercles anteriorly and medially, tubercles of posterior portion of carapace confined to outer slope. Front produced medially, divided by a narrow, button-hole slit into two concave lobes, each with an outer lobule. Orbital border smooth, inner margin swollen, outer margin with two superior notches, lower margin with an outer notch and an external and internal tooth. Anterolateral margin arcuate, edge thin, denticulate, divided by grooves into four larger teeth excluding the exorbital tooth, first tooth a cluster of tubercles, second tooth low, tuberculate, third and fourth teeth prominent, triangular, blunt-tipped, fourth tooth flattened, directed horizontally, making a shallow angle with the straight or slightly convex posterolateral margin.

External maxilliped smooth, punctate, glabrous, ischium grooved, merus dimpled, strongly produced at anteroexternal angle, anterior margin concave.

Subhepatic and pterygostomian regions finely tuberculate above, smooth below.

Chelipeds subequal, merus, carpus, and manus mostly smooth but with some low, scabrous tubercles interspersed with fine hairs. Merus crested above, grooved and notched distally; carpus smooth above, tuberculate and grooved externally, tuberculate and hirsute internally, a stout spine at inner angle and a tubercle beneath; manus tuberculate above, with five or six larger tubercles forming a superior crest; outer surface of palm largely smooth and bare, with faint indication of tuberculate ridges continuing on pollex. Dactylus with an entire superior crest and an external carina, meeting pollex with two teeth in narrow gape; pollex slightly deflexed, basally grooved, bearing five prominent teeth of which the second tooth is largest, the last terminal.

Walking legs compressed, the merus, carpus, and propodus crested above, the merus doubly and the propodus singly crested below. Surfaces smooth or faintly etched, dactyli straight or slightly curved, edges furred.

Male abdomen with segments 1 and 3 slightly wider than segment 2, segments 3 to 5 fused, transverse bars on segments 2 to 4 becoming fused and obsolete on segments 5 and 6, abdomen narrowest opposite base of segment 6, segment 7 with sides angularly concave, tip rounded. Female abdomen smooth and punctate, a suggestion of fused tubercles marginally.

Male first pleopod slender, cylindrical, gradually tapering and curving toward tip; convex margin with a row of 23 to 24 long, feathered setæ distally and a row of short setæ proximally; concave margin with one or more rows of short setæ proximally and a single longer seta at base of beaklike tip.

The outer maxillipeds and last pair of walking legs are missing from the smaller male paratype, the abdomen and its appendages from the larger; hence the selection of the female specimen as holotype.

Remarks. – The proposed new species differs from *Demania scaberrima* (Walker),2) the most nearly related species for which full description and illustration are available, in having the carapace much less scabrous on the anterior three-fifths, areoles 1M, 2M, 3M, 4M, 1L, 2L, 5L, and 6L (of Dana),3) being entirely smooth, in having the front more advanced medially, the orbits smooth, the anterolateral teeth more salient, especially the last tooth, which forms an obtuse angle with the straight posterolateral border, the chelipeds much less scabrous, particularly the upper surface of the carpus and external surface of the manus, the superior margin of the dactylus entire and with only one outer carina, the walking legs all alike (the merus of the last not spinulous), their rims entire above and below, their meri lacking a subterminal notch. It is apparently nearer to *D. cultripes* (Alcock)4)† (non Sakai),5) which it resembles in having the tubercles on the mesogastrium not only "still more worn" [than *D. baccalipes* (Alcock),] 4) but entirely absent and the carpus of the cheliped with a stout spine at its inner angle (from the Serène key, unpublished). It differs from *D. cultripes,* however, in having the tubercles near the inner angle of the wrist and near the base of the thumb entirely absent, leaving the carpus and outer surface of the manus smooth and bare, and in having the raised rows of granules on the dorsal surface of the leg-joints obsolete, rather than obsolescent. It should be noted that the presence or absence of tuberculation depends to some extent on the age and size of the individual, and that the younger of the two males approaches *D. cultripes* more closely in this particular.

The larger male paratype was mistakenly referred to *Demania toxica* Garth1) in a note added in proof to the description of that species.

†The *Demania cultripes* mentioned above is the *Xantho (Lophoxanthus) cultripes* of Alcock,4) the *Xantho reynaudii cultripes* of Sakai,5) being recognized as *Demania rotundata* (Serène),6) (Serène and Lohavanijaya).7)

REFERENCES

(1) J. S. Garth, Micronesica, **7** (1971), 179.

(2) A. O. Walker, *J. Linn. Soc. Lond., Zool.,* **20** (1887), 107.

(3) J. D. Dana, United States Exploring Expedition During the years 1838, 1839, 1840, 1841, 1842, under the command of Charles Wilkes, U.S.N. Vol. 13, Crustacea: (viii) 1618, Phila., 1852.

(4) A. Alcock, *J. Asiat. Soc. Bengal,* **67** (1898) 67.

(5) T. Sakai, Studies on the Crabs of Japan, IV. Brachygnatha, Brachyrhyncha, Tokyo, 1939, p. 365.

(6) R. Serène, *Cah. Pac.,* **13** (1969), 223.

(7) R. Serène and P. Lohavanijaya, *Naga Rep.,* **4** (4) (1973), I.

PHILIPPINE LIVERWORTS. III.* CALOBRYALES AND HERBERTALES OF THE PHILIPPINES

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ABSTRACT

Two orders of Hepaticæ in the Philippines are described. The Calobryales, perhaps the most primitive and represented only by *Haplomitrium giganteum*, are without rhizoids, with leaves either flat, unlobed or formed of two to four segments. The order seems a direct transition to mosses with which it has similar critical features.

The Herbertales with three suborders, eight families, and 91 species are primitive liverworts with well-developed leaves and underleaves varying from two to eight lobes or are indistinctly lobed, with few rhizoids found only at the bases of underleaves.

Suborder Herbertineæ has erect to ascending plants which are radially symmetrical. The leaves are symmetrical with similar underleaves that are slightly smaller. Within the Herbertineæ, Herbertaceæ is represented by *Herberta* with 13 species. Isotachidaceæ has two species of *Isotachis*. *Blepharostomataceæ* has only *Blepharostoma trichophyllum*.

Suborder Ptilidiineæ is nearly isophyllous, usually prostrate or sometimes pendulous. The leaves are asymmetrical and the underleaves are different in form. Within the Ptilidiineæ, Ptilidiaceæ is represented by *Mastigophora* with two species. In Lepicoleaceæ, *Lepicolea*, one in Trichocoleaceæ *Trichocolea*, nine; and *Temnoma*, one.

Suborder Lepidoziineæ consists of anisophyllous plants with underleaves much smaller than the lateral leaves. Within the Lepidoziineæ, Lepidoziaceæ includes: *Acromastigum*, four species; *Bazzania*, 34; *Psiloclada*, one; *Lepidozia*, 13, *Teleranea*, four; *Zoopsis*, one; *Microlepidozia*, two. In Calypogeiaceæ, *Calypogeia*, has two species and *Metacalypogeia*, one.

INTRODUCTION

The Calobryales, a highly distinct order, are among the orders of Hepaticæ with only a few species. The order originally included two genera, *Haplomitrium* (with one known species *H. hookeri* from Europe and N. America) and *Calobryum* with six to seven species described but Schuster1) believes that only five or six appear to be valid (*C. blumei* in the East Indies, *C. andinum* in

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*Philippine liverworts I and II appeared in Philipp. J. Sci., **95** (1967) and **100** (1971) respectively.

Philipp. J. Sci., 104(1-2), 1975: 7-72.

the West Indies and Andes of South America, *C. rotundifolium* in Japan, *C. giganteum* in the Philippines, and *C. gibbsiæ* in New Zealand).

Haplomitrium and *Calobryum* differ from all others in that the basal part of the plant consists of a branched, creeping rhizomelike stem where erect leafy shoots arise, with their leaves radially disposed. The creeping stem lacks rhizoids. The leaves are simple and entire, of the three ranks one is sometimes of appreciably smaller size, and this has been equated with the amphigastria of Jungermanniales. Both genera are dioicous. *Haplomitrium intermedium,* a recently described species has a scattered position of archegonia, and therefore connects the two genera – the anacrogynous *Haplomitrium* and the acrogynous *Calobryum.* For that reason Schuster2) has merged all the species in the single genus *Haplomitrium.*

Hattori and Mizutani3) described a very remarkable new liverwort from Japan and later found in Western North America. It has been named *Takakia lepidozioides* and made the basis of a new order, Takakiales. The species is unique in the form of leaves (each leaf unit is divided into two solidly parenchymatous cylindrical structures), in the lack of rhizoids (also typical of Calobryales), and in the low chromosome number. After much investigation, however, *Takakia* was found better placed within the Calobryales, although in an independent suborder, Takakiinæ.

Haplomitrium belongs to the other suborder-Calobryineæ. The gametophytic features common to *Takakia* and *Haplomitrium* are: the identical nature of the branching, the free development of a coralloid rhizome, the secretion of large quantities of mucilage, the large archegonia, the frequent occurrence of scattered sex organs, and the joint lack of rhizoids.

Schuster1) who has done a very good monograph of the Calobryales discusses clearly their affinities to other orders. According to him, the group shows almost no resistance to drought, in which it approaches the majority of Metzgeriales, an order to which there are other similarities, e.g., the often scattered sex organs, the anacrogynous position of the archegonia; lack of collenchyma; the often rather large cells; the occasionally copious secretion of mucilaginous matter. However, the affinities of the order are remote, but are more likely to be closer to the Metzgeriales than to the Jungermanniales (s. lata) in spite of the fact that the organization is not only leafy, as in Jungermanniales but is usually basically triradial and virtually isophyllous, as in primitive Jungermanniales. Both Calobryales and Metzgeriales have exceedingly attenuated and long elaters often 350 to 500 μ long or more but only 6 to 10 μ in diameter. By contrast, the elaters of Jungermanniales are typically much shorter, rarely exceeding 300 μ in length and often fail to exceed 100 to 150 μ long.

Since the Calobryales show many primitive features, they may well be placed at the beginning of the Hepaticae. It appears, therefore, that they form a direct transition to the mosses and share with them a large number of critical features:1)

1. Often virtually radial organization and erect growth.
2. Triseriate leaf arrangement and often isophyllous condition.
3. Irregularly scattered antheridia (in *Calobryum* supposedly in a terminal disc, as is frequently the case in Musci; in *Haplomitrium* irregularly over the stem surface and not directly associated with the axil of a leaf).
4. Very long neck of the archegonium, with a large number of neck canal cells, as many as 40 (*H. gibbsiæ*; E. O. Campbell).4)
5. Antheridial development, as regards the terminal cell of the original filament produced by transverse divisions, is similar to that in the Musci. In both cases, three eccentric oblique divisions cut off three jacket initials and an inner, fertile cell. In both cases there is development of an unusually long stalk of the antheridium; similarly elongate stalks are quite unusual in other Hepaticæ. The quadriseriate antheridial stalk is also unusually massive.
6. The leaf develops by means of single apical cell with two cutting faces and later by intercalary division in the basal region of the leaf. This is similar to growth in mosses, but unlike that of the Jungermanniales.
7. A central strand of conducting cells is present in the axis of the gametophyte, as in many mosses, although this may be poorly marked.

The Herbertales are considered to be the most primitive group of leafy liverworts except for the very small order Calobryales, which are represented in the Philippines by a single species. The more primitive genus like *Herberta* shows a nearly isophyllous condition. The Lepidoziaceae are illustratives of the transition from the more or less isophyllous *Microlepidozia makinoana* to the clearly anisophyllous species of *Bazzania*. Other primitive features of the order include: the well-developed leaves and underleaves which vary from entire to 8-lobed; the leaf insertion varies from transverse to incubous; the branching types are extremely variable from being only ventral intercalary as in

Herberta to any one of the types of lateral terminal branching; the rhizoids are few and are found only at the bases of underleaves.

The Herbertales include certain taxa which are wide-spread in both hemispheres and common in temperate to tropical rain forests. As here defined, the order corresponds to the Ptilidiines (*s. lata*) which has been subdivided by Schuster[1)] into three suborders (Ptilidiineæ, Herbertineæ, and Lepidoziineæ), and adopted in this work. This group with more or less isophyllous taxa represents the most primitive of extant Jungermanniales (*s. lata*). The Herbertales, therefore, as here circumscribed, are separated from the Jungermanniales. This system was first proposed by Miller (in Sched.) in a similar manner.

The important characters which readily separate the Herbertales from the Jungermanniales are: leaves and underleaves both plane limited, the leaf insertion mostly incubous to transverse, rhizoids few and borne at base of the underleaf, asexual reproduction, e.g., gemmæ production very rare, confined almost entirely to *Blepharostoma* and to the relatively specialized Calypogeiaceæ and Lepidoziaceæ. The Jungermanniales with deletion of the Herbertales (Ptilidiineæ, Herbertineæ and Lepidoziineæ) are distinguished by succubous and plane or with a reduced plane dorsal lobe, not isophyllous, underleaves small to absent, rhizoids mostly scattered along the stem, asexual reproduction is common, most frequently by means of one to two-celled conidialike bodies (gemmæ) that are often produced in masses of fascicles, single discoid bodies are never developed.

ACKNOWLEDGMENT

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TAXONOMIC TREATMENT

Order CALOBRYALES

Plants erect, green, leafy and usually radial (if dorsiventral, smaller row of leaves dorsal), with intercalary-exogenous branching, the branch initial a tetrahedral apical cell cut off from a cortical cell usually from older tissue, terminal branching occasionally produced in *Takakia* and *Haplomitrium intermedium*. Stems terete, fleshy with a several-layered chlorophyllose, ill-defined, soft textured cortex, and an ill-defined "central strand" of smaller, elongated cells. Rhizoids lacking. Leaves triseriate, soft-textured, subtransverse to oblique, either a flat undivided lamina or formed of (1) 2-4 fleshy, terete, polyseriate segments that are free to the base and often appearing to arise more or less independently of each other. Cells large, thin-walled or more or less feebly, equally thick-walled, smooth noncollenchymatous, with many small chloroplasts per cell; with several to very many, finely granular-botryoidal to glistening, minute, homogeneous-appearing oil bodies per cell. No asexual reproduction.

Dioicous. Antheridia (Haplomitriinæ) either in a terminal group, axillary to the three distal bracts, or else several per axis of more or less, spaced male bracts (which are usually congregated in a "terminal head"), or in part, isolated and scattered on stem (often infra-axillary) or aggregated into more or less defined terminal heads, their formation apparently never involving the apical cell (or, at least, only sporadically so), hence, plants anacrogynous; in absence of fertilization, shoot tip at least facultatively continuing its growth after archegonium formation. Archegonia massive, large; neck formed of either 4 or 6 rows of cells. Sporophyte (Haplomitriinæ) massive with a very massive somewhat chlorophyllose seta, of numerous cell rows; capsule ellipsoidal or cylindrical-ellipsoidal, with wall 1 – stratose, thickening bans 1 (-2) per cell, vertically oriented, spores with exine rather thin, with faint markings (papillæ or areolæ), about 3 to 4 times elaters in diam; elaters long, slender, (1-) 2 to 3 spiral free sporophyte protected by "calyptra" (shoot-calyptra) which is derived only in small part from the archegonial venter.

Suborder CALOBRYINEÆ

Characteristics of the single family.

FAMILY CALOBRYACEÆ

Plants varying from radially symmetric to anisophyllous. Leaves ovate to reniform-orbicular, flat, unlobed, unistratose or polystratose towards base only, slime papillæ of a single type, the stalked type. Archegonia aggregated in a terminal group on a dilated disc, then (plants acrogynous) or not (then plants anacrogynous in absence of fertilization) but archegonium production always resulting in swelling of the shoot tip. Sporophyte surrounded by a cylindrical, green to yellowish, fleshy, brittle, massive "shoot calyptra" capsule ellipsoidal-cylindrical, brown, with wall 1- stratose; cells of wall elongated, each with 1(-2) annular, longitudinally oriented brown thickening bands.

Genus HAPLOMITRIUM Nees

Haplomitrium Nees, Naturg, Eur. Leberm., 1 (1833), 109.

Plants green, fleshy and soft-textured to occasionally brittle, erect, radial and developing three subequal rows of leaves or anisophyllous, stem with weakly defined strand of smaller, more elongate cells and a peripheral parenchymatous cortical region, lacking rhizoids. Leaves entire or subentire, elliptical to broadly orbicular – subreniform to obovate-obdeltoid, formed of large thin-walled noncollenchymatous cells, all cells with distinct oil bodies, several per cell. Antheridia, at least partially scattered over the axis, partially in or near the axils of all three rows of leaves, not aggregated in a terminal group. Archegonia naked, in groups of two to five or to over 25, produced on all faces of the stem, or more or less clustered at the very apex of the axis. Subsequent to fertilization the receptacular tissue becomes meristematic at the base of the fertilized archegonium, forming a tubular shoot-calyptra or stem perigynium.

HAPLOMITRIUM GIGANTEUM (Steph.) Groll. **Fig. 1.**

Tylimanthus giganteum Steph., Spec. Hepat., 6 (1922), 247.
Calobryum giganteum Grolle, J. Hattori Bot. Lab., 26 (1963), 1, 5.
Haplomitrium giganteum, (Steph.) Grolle, Oesterr. Bot. Zeitscher., III (2-3) (1964), 191.

Plants green (olive-green in herbarium material) with leafy shoot portion erect or ascending, at base with a system. Of leafless stolonlike rhizomes; rhizoids lacking. Stems thick, green, straight to 6 cm tall, with leaves 6 to 9 mm wide unbranched in the leafy region, but at base freely developing leafless rhizomatous branches. Cortical cells rectangular, thickenings lacking, strongly anisophyllous; lateral leaves large, except towards base of leafy shoots where almost lacking to scalelike, rapidly larger distally very strongly succubously inserted, leaves not contiguous, ventral end of insertion more or less arched, the line of insertion otherwise straight; leaves not contiguous, planodistichous, rather obliquely oriented (with regard to shoot-apex), the lamina flat or on dorsal margin towards base convex (in ventral aspect), unistratose to base; leaves unlobed, variable in size and outline, but always appreciably narrowed in basal one-third to one-half, predominantly obovate to broadly obcuneate, ca. 2.9 to 3.2 mm wide by 3.0 to 3.5 mm long or even larger, normally slightly to appreciably longer than wide, margins irregularly undulate, apex blunt to truncate. Cells leptodermous, cuticle smooth, near apices rather isodiametric, 40 to 50 by 40 to 50 μ, towards base strongly elongated and 40 to 50 by 65 to 12 μ. Dorsal leaves very remote, free, much smaller than lateral leaves and very different in shape,

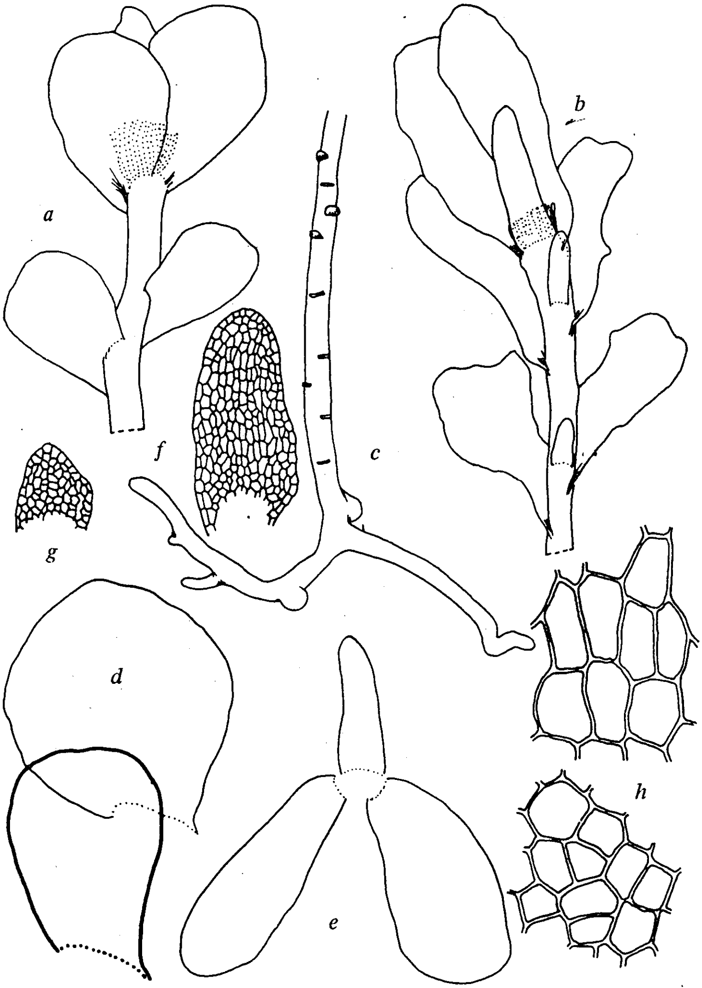

FIG. 1. *Haplomitrium giganteum* (Steph.) Grolle: *a.* ventral portion of a stem with archegonia, x 4; *b.* same but dorsal portion, x 4; *c.* stolonlike rhizome with erect shoot, x 4; *d.* lateral leaves, x 10; *e.* involucral leaves, x 4; *f.* dorsal stem leaves, x 25; *g.* middle leaf cells of subapical leaf, x 120; *h.* leaf cells of basal leaf, x 120. All from type specimens. (After Grolle, 1963.)

narrower than stem, angularly ovate-triangular to ovate-lingulate, rounded at apex.

Dioicous. Gynoecia terminal and without apparent innovation. Gynoecial leaves free, similar to stem leaves but rather larger and strongly elongated, bracts narrowly obovate-lingulate, 2.1 to 3 mm wide by 5.5 to 6 mm long, succubously oriented; dorsal involucral leaf free, entire, strongly elongate-ovate to lingulate, much shorter and narrower than the bracts (1 to 1.2 mm wide by 3.5 to 4.5 mm long). Archegonia numerous, well over 20 per gynoecium, in a well-defined apical group, without evident innovation.

MINDANAO, *Elmer 11562 (G)*, type of *Tylimanthus giganteus*.

Distribution: Known only from the type in the Philippines.

Schuster[5)] describes *H. giganteum* as distinctive and is the largest species which forms the end point in evolution of the Calobryales. Among members of the order it has the most marked anisophylly, with the third (dorsal) row of leaves, only 0.05 to 0.2 the area of the lateral leaves. The species is pseudacrogynous or may be truly acrogynous.

Order HERBERTALES

Plants with well-developed leaves and underleaves, either or both of which may be variable in form, from 2 to 8-lobed to entire, not or weakly anisophyllous; underleaves equal to leaves but usually 0.3 to 0.5 their size or smaller; rarely developing gemmæ. Leaf insertion varying from transverse to incubous. Rhizoids often rare, occurring only on the bases of a few underleaves on each stem and always restricted to small specialized, rhizoid initial regions. Female inflorescence usually with a perianth and several whorls of involucral leaves, i.e., bracts and bracteoles, with the innermost greatly modified. Male spike various. Sporophyte with foot, elongate and thickened seta, a four-valved capsule with valves sometimes secondarily split, and long, sometimes tapered, spiral elaters.

The classification of the Philippine Herbertales is as follows:

- Suborder Herbertinæ
  - Herbertaceæ
    - *Herberta* (13 species)
  - Isotachidaceæ
    - *Isotachis* (2)
  - Blepharostomataceæ
    - *Blepharostoma* (1)
- Suborder Ptilidiineæ
  - Ptilidiaceæ
    - *Mastigophora* (2)
  - Lepicoleaceæ
    - *Lepicolea* (1)
  - Trichocoleaceæ
    - *Trichocolea* (9)
    - *Temnoma* (1)
- Suborder Lepidoziineæ
  - Lepidoziaceæ

Acromastigum (4)
Bazzania (34)
Psiloclada (1)
Lepidozia (13)
Telaranea (4)
Zoopsis (1)
Microlepidozia (2)
Calypogeiaceæ
Calypogeia (2)
Metacalypogeia (1)

Key to the suborders of Herbertales

1. Plants usually subisophyllous; underleaves large, 0.5 to 1.0 the size of leaves; sexual branches always elongated, leafy, never reduced in size; male bracteoles large, sometimes with antheridia; hyaline epidermal cell layer (hyaloderm) in stem or seta never present 2
1. Plants usually anisophyllous; underleaves usually not more than 0.5 the size of lateral leaves; sexual branches usually short, mostly intercalary and postical in origin; male bracteoles without antheridia; hyaloderm often present . . . . Suborder 3. Lepidoiineæ
    2. Plants most often erect to ascending from a rhizomelike axis; always approaching radial symmetry; never regularly pinnately branched; branches ventral intercalary; leaves more or less symmetrical; 2 to 4 lobed; underleaves usually similar . . . . . Suborder 1. Herbertineæ
    2. Plants usually prostrate, sometimes pendulous, rarely strongly ascending, usually regularly one to three pinnate, leaves more or less asymmetrical, underleaves differing in form from leaves Suborder 2. Ptilidiineæ

Key to the genera of Herbertales

1. Leaves and underleaves undivided or emarginate to minutely bidentate. . 2
1. Leaves and underleaves variously divided 4
    2. Leaves and underleaves undivided, stems producing postical flagella . . *Bazzania* (Integrifoliæ)
    2. Leaves and underleaves emarginate or minutely bidentate; stems without postical flagella 3
3. Plants opaque and deep green; stems pseudodichotomously branched; leaves *Bazzania*-like, often pointed or bidentate; capsule ovoid with straight valves . . . . *Metacalypogeia*
3. Plants usually transluscent and delicate; stems with ventral intercalary branches; leaves usually rounded or blunt-pointed; capsule cylindrical with twisted valves . . . . *Calypogeia*
    4. Leaves divided into filiform segments 5
    4. Leaves not divided into filiform segments 9
5. Lamina of leaves not conspicuous; leaves deeply divided 6
5. Lamina of leaves conspicuous; leaves with shallow sinuses . . . *Temnoma*

6. Leaf segments unbranched, entire, capillaceous; leaves transversely inserted 7

6. Leaf segments variously branched or ciliate; leaves succubously inserted . . . . *Trichocolea*

7. Stem with hyalodermis; leaf lobes formed of delicate, elongate cells (50 to 100 μ) that often collapse on drying; cuticle smooth; shiny when dry. *Telaranea*

7. Stem without a conspicuous hyaloderm; leaf lobes formed of short rigid cells (less than 50 μ); cuticle usually verruculose; dull when dry 8

8. Leaves with lobes uniseriate to base, septa transverse in lobes with external thickening; plants irregularly monopodially branched. *Blepharostoma*

8. Leaves with lobes 2 to 4 cells wide at base; septa transverse without external thickening; plants regularly pinnately branched, *Microlepidozia*

9. Leaves bifid to bisbifid or toothed 10

9. Leaves 3, 4, to many-lobed 14

10. Plants thalloidlike; leaves bilobed, reduced to a pair of thin-walled cells . . . . *Zoopsis*

10. Plants not thalloidlike; leaves larger than 2 cells 11

11. Stem with a hyaloderm layer; leaf lobes unequal; underleaves trifid. *Acromastigum*

11. Stem without a hyaloderm layer; underleaves various 12

12. Plants suberect to erect; irregularly branched; underleaves similar in form to leaves 13

12. Plants prostrate; furcately branched; underleaves different from leaves . . . . *Bazzania*

13. Leaves distinctly vittate; deeply bifid (0.5 to 0.75); segments lanceolate, often falcate, entire, cells with coarse trigones . . . . *Herberta*

13. Leaves not distinctly vittate, shallowly bifid (less than 0.3-lobed), margins toothed, cells without trigones . . . . *Isotachis*

14. Leaves incubous; 3 to 4-lobed; lobes without fingerlike terminal cells 15

14. Leaves succubous; 5 to 7-lobed; lobes with erect fingerlike terminal cells at right angles to the lamina . . . . *Psiloclada*

15. Plants usually subisophyllous; underleaves large, at least 0.5 the size of leaves; sexual branches always elongated 16

15. Plants usually more or less anisophyllous; underleaves smaller; sexual branches short 17

16. Leaves very asymmetrical; 3-lobed; underleaves bilobed with a conspicuous appendage on each side; perianth present *Mastigophora*

16. Leaves more or less symmetrically 3 to 4-segmented; underleaves similar; coelocaule present . . . . *Lepicolea*

17. Stem pinnately branched; postical flagella near base of stem; leaves 4 or rarely 2 to 3-lobed for about half of their length; underleaves sometimes similar to leaves in size and shape or smaller and trapezoidal with 3 to 4 blunt teeth . . . . *Lepidozia*

17. Stem pseudodichotomously branched; flagella many from ventral size; leaves usually tridentate; underleaves always far smaller than leaves; entire to erose-dentate . . . . *Bazzania*

Suborder 1. HERBERTINEÆ

Plants erect to suberect often from a rhizomelike primary axis or prostrate, nearly isophyllous. Stem never regularly pinnate, always monopodial and irregular, both lateral and postical intercalary branching produced, with lateral *Microlepidozia*-type branching, and with postical, terminal, *Acromastigum*-type branching; flagella or postical stolons normally absent. Leaves ranging from bifid (rarely trifid) to bisbifid to symmetrically or rarely symmetrically quadrifid; lobe margins entire or dentate to long-ciliate or, sometimes the leaf reduced to 2 to 4 filiform uniseriate lobes. Underleaves 2 to 4-lobed, identical in form and size to leaves or considerably smaller and often with fewer lobes. Gemmæ produced only in *Blepharostoma.* Dioicous to monoicous. Antheridial spikes intercalary on main axis, bracts leaflike but often less deeply lobed, bracteoles large, sometimes (Herbertaceæ) with antheridia in their axils; antheridia 1-several with the stalk 1 to 4 seriate. Female inflorescence terminal on leading stems, archegonia numerous; perianth present (Herbertaceæ, Blepharostomataceæ) or replaced by a terminal fleshy perigynium (Isotachidaceæ).

Key to the families of suborder Herbertineæ

1. Leaves either deeply and equally bifid or somewhat asymmetrically and shallowly 2 to 3-lobed at apex only, incubously inserted, subtransversely oriented, leaf margins entire or toothed 2
1. Leaves usually symmetrical or nearly so, 3 to 4-lobed for 0.7 to 0.95 their length, the lobes filiform, insertion transverse . . . Blepharostomataceæ
    2. Leaves deeply bifid with narrow segments, asymmetric and somewhat falcate, entire above; antheridial bracteoles with antheridia; perianth distinct; capsule ovoid to spherical . . . . Herbertaceæ
    2. Leaves usually relatively broad, symmetrical or subsymmetrical, not falcate, 2 to 4-lobed at apex, sometimes median sinus deeper, toothed above . . . . Isotachidaceæ

Family HERBERTACEÆ

Plants medium-sized to robust, golden brown to reddish brown with erect leafy stems arising from a rhizomatous, soon leafless stem. Branches normally ventral intercalary, from the axils of underleaves with some normal and others more or less stoloniferous with reduced scalelike leaves. Leaves incubous to nearly transverse, bifid (rarely trifid), often curved, sometimes secund, asymmetrical, often ornamented with slime papillæ along the basal disc, margins otherwise mostly entire along the narrowly triangular segments. Leaf cells mostly with large nodular trigones, the central rows in *Herberta* elongate in a canaliculate band (vitta) extending into or through each segment. Underleaves mostly similar to leaves but transversely inserted, slightly smaller, symmetrical and often recurved above. Dioicous, often sterile. Male spikes intercalary on main leafy shoots with both bracts and bracteoles bearing 2 to 3 antheridia with long stalk. Female inflorescence terminal with several whorls of bracts and bracteoles subtending a 3-angled, often 6-plicate, and deeply laciniate, perianth. Capsule borne on a thick seta, nearly spherical, the 4 valves usually split secondarily and the sporangium wall 4 to 7 cell layers thick.

The Herbertaceæ is composed of 83 species in five genera, which are mostly of high southern latitudes. *Herberta*, with about 75 species, is the only widely distributed genus in both hemispheres, and is known in wet temperate to tropical forests. Only *Herberta* is known from the Philippines where it forms great masses on tree trunks in cloud forests.

Genus HERBERTA S.F. Gray

Herberta S.F. Gray, Nat. Arr. Brit. Pl., 1 (1821), 705.

Plants large and rigid, reddish brown. Stems arising from a slender, rhizomatous base, procumbent or erect; branches ventral, intercalary (rarely with ventral stolons, arising from axils of underleaves, very rarely with intercalary lateral branches; rhizoids on rhizomatous stem, largely restricted to the bases and or distal portions of underleaves (rarely on the leaf bases). Leaves incubous or almost transversely inserted, bifid (rarely trifid), usually for 0.3 to 0.8 their length, the lobes acute to acuminate and narrowly triangular to lanceolate, often falcate, the leaves often somewhat ventrally secund, asymmetrical, leaves not ciliate or dentate, but basal undivided portion of leaf with the margins generally bearing on each side several to many evanescent slime papillæ, which vary from sessile to stalked (in which case the leaf bases are evidently dentate or ciliate), the lobes with the margins entire. Underleaves similar to leaves, but symmetrical and sometimes slightly smaller, bifid like them, the lobes parallel to slightly divergent, not secund; both leaves and underleaves more or less imbricate; cells strongly collenchymatous, the trigones coarse and bulging; a median basal group of basal cells somewhat elongated, rectangular, mostly giving rise to a vitta extending into each lobe, surrounded by more nearly isodiametric cells; leaf surfaces striolate to verrucose. Androecia near end of stem or branches; bracts few, 4 to 8 pairs, nearly resembling the leaves, but less deeply bilobed, ventricose at base, the margins strongly recurved and with papilliform teeth at the base; bracteoles also with antheridia; antheridia 2 to 5 per perigonial leaf. Female inflorescence terminal; bracts several, closely imbricate, surrounding and almost concealing the perianth; perianth narrow ovate-subulate, tricarinate, the mouth plicate and deeply laciniate. Capsule large, globose, 4-valved, the valves frequently bipartite.

Key to the genus Herberta

1. Leaf segments circinate, with the postical segment reduced . *H. circinata*
1. Leaf segments straight to curved with segments subequal or the antical reduced 2
    2. Leaf tips often filiform; cells elongate-cylindrical derived from vitta 3
    2. Leaf tips acuminate, cells short-cylindrical derived from lamina . . 5
3. Leaves bifid 3/4 or less with narrowly lanceolate to lanceolate segments . . *H. divaricata*
3. Leaves bifid about 4/5 with linear-lanceolate segments 4
    4. Cells of leaf base thin-walled with large nodular trigones, slime papillæ mostly long-stalked . . . . *H. angustissima*
    4. Cells of the base thick-walled with reduced trigones, slime papillæ sessile or short-stalked . . . . *H. longispina*
5. Leaves bifid 1/2 or less, largely composed of isodiametric cells 6
5. Leaves bifid 2/3 or more, largely composed of elongate vitta cells 7
    6. Leaf segments curved; leaf cells with trigones larger than diameter of lumen . . . . *H. javanica*
    6. Leaf segments straight; leaf cells with trigones not exceeding diameter of lumen . . . . *H. handelii*
7. Plants delicate; leaves about 1 mm long, very brittle . . . . *H. fragilis*
7. Plants medium to large; leaves about 2.0 mm long or longer 8
    8. Leaves with linear segments and an undulate basal disc margin . . . . . . *H. decurrens*
    8. Leaves with lanceolate and a plane or involute margin below, if undulate then irregularly armed below 9
9. Leaf and underleaf basal disc wider than long; leaves bifid about 4/5 . . . . *H. adunca*
9. Leaf and underleaf basal disc longer than wide; leaves bifid 1/2 to 3/4 . . 10
    10. Plants long and slender; leaves less than 2 mm long, leaf segments nearly straight . . . . *H. parisii*
    10. Plants medium to robust; leaves more than 2 mm long, leaf segments slightly to strongly curved 11
11. Leaves bifid about 1/2; ovate to oblong or deltoid 12
11. Leaves bifid 2/3 to 3/4; broadly oblong to orbicular, slightly cordate-decurrent; leaf segments slightly curved . . . . *H. longifolia*
    12. Leaves ovate-oblong, long decurrent, clasping, leaf segments slightly curved . . . . *H. chinensis*

12. Leaves almost deltoid, little decurrent, not clasping, leaf segments strongly curved . . . . *H. milleriana*

HERBERTA CIRCINATA (Steph.) Miller. **Fig. 2.**

Schisma circinatum Steph., Spec. Hepat., 4 (1909), 25.
Herberta circinata (Steph.) Miller, J. Hattori Bot. Lab., 28 (1965), 318.

Plants robust, reddish brown. Stem sparingly branched with some short-tapered, arcuate, ventral intercalary, microphyllous branches, 120 by 0.3 mm. Leaves imbricate, strongly secund, regularly hamate, decurrent, oblong, 2.0 to 3.1 by 0.7 to 1.0 mm, bifid about 2/3 to 3/4 with a narrow sinus and attenuated unequal segments with the antical being larger; basal disc rectangular-ovate

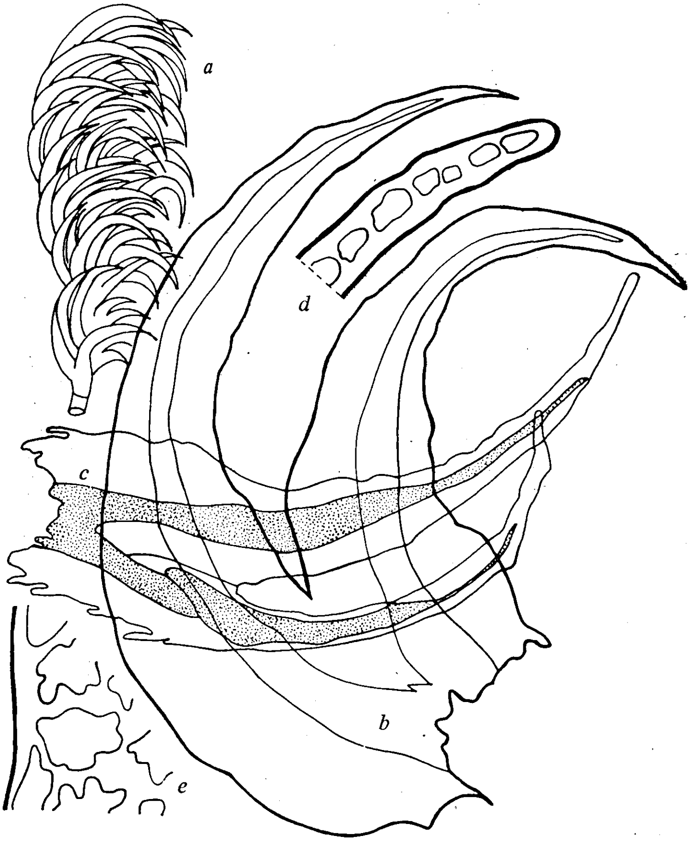

FIG. 2. *Herberta circinata: a.* portion of a plant, x 15; *b.* leaf, x 45; *c.* underleaf, x 45; *d.* apical leaf cells, x 550; *e.* basal leaf cells, x 550.

with a ciliate margin; vitta very strong, apparently compressing much of the leaf, concave canaliculate throughout the base and segments; leaf cells with thick walls, and nodular trigones almost as large as diameter of lumen, papillose. Underleaves similar to leaves but straight and so strongly reflexed thus almost forming a loop, 1.5 to 2.3 by 0.4 to 0.7 mm. Dioicous. Male plants smaller; bracts and bracteoles ciliately margined as in leaves and underleaves but the erect cilia extend well beyond basal disc. Female inflorescence terminal with about 5 whorls of strongly falcate-secund bracts and bracteoles subtending the hamate perianth.

MINDANAO, Davao, Mt. Apo, *Miller 10798, 10844, 11083, 11091, 1135, 1168, 11169, 1176, 11239, 11255, 11268, 11278; Pancho 9054.*

Distribution: New Guinea, new to the Philippines.

This species is easily distinguished from other members of the genus by the extreme curving of the leaf segments, reduction in size of the postical segment, and the leaf cells with nodular trigones which are almost as large as the lumen.

HERBERTA DIVARICATA (Herz.) Miller. Fig. 3.

Schisma divaricatum Herz., Bot. Centrabl. Bech., 38 (1921), 326.
Herberta divaricata (Herz.) Miller, J. Hattori Bot. Lab., 28 (1965), 325.

Plants moderately robust, dark golden to olive-brown. Stems 50 by 0.2 mm, sparsely branched. Leaves closely imbricate, curved, strongly falcate-secund when dry and less so when moist, little decurrent, oblong, 2.0 to 2.6 by 0.4 to 0.8 mm, bifid about 3/4 with abruptly narrowed, lanceolate, acuminate segments separated by a rounded acute sinus; basal disc ovate and dentate by virtue of short-stalked slime papillæ, vitta strong, concave, becoming bifid about midway in the disc and extending into the segment tip; leaf cells faintly papillate, thin-walled with large, nodulose, often confluent, trigones 1/2 to about equal the diameter of lumen. Underleaves bifid about 2/3, smaller than leaves with straight oblong rectangular base and strongly reflexed, widely spread segments.

LUZON, Benguet, Mt. Pulog, *Miller 10332, 10563, 1666, 1688.*

Distribution: Ceram, new to the Philippines.

The diagnostic characteristics of the species are the widely divergent segments of underleaves. It differs from *H. angustissima* and *H. longispina* by being smaller and more delicate.

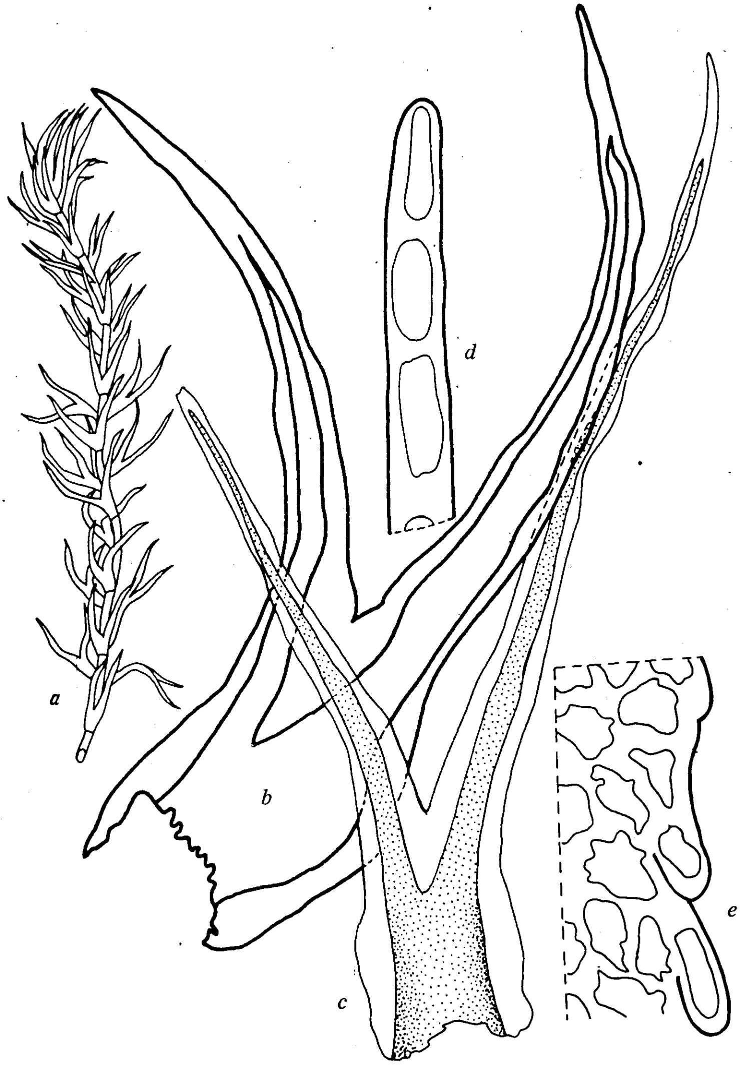

FIG. 3. *Herberta divaricata: a.* portion of a plant, x 10; *b.* leaf, x 45; *c.* underleaf, x 45; *d.* apical leaf cells, x 550; *e.* basal leaf cells, x 550.

HERBERTA ANGUSTISSIMA (Herz.) Miller. Fig. 4.

Schisma angustissimum Herz., Annal. Bryol., 5 (1932), 79.
Herberta divaricata (Hertz.) Miller, J. Hattori Bot. Lab., 28 (1965), 325.

Plants medium to large, golden-brown. Stem reddish-brown, 120 by 0.2 mm with scattered ventral intercalary branches bearing reduced, but more or less typical leaves. Leaves distant, basal disc approximate, crisped when dry and squarrose to recurved-spreading when moist, more or less cordate basally, 2.5 to 3.5 by 0.5 to 0.6 mm, bifid 3/4 to 4/5 with an acute sinus and subacicular segments; basal disc oblong-rectangular with an undulating margin above the retrorse slime papilla bearing teeth below; vitta deeply depressed below, becoming canaliculate to midsegment or beyond, bifid from above mid-disc and becoming

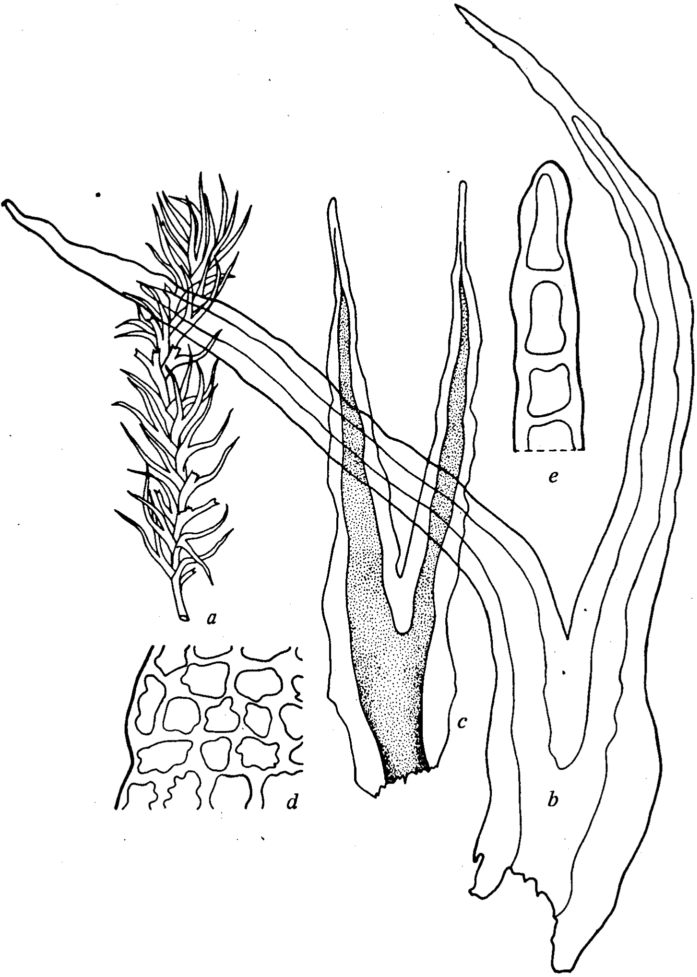

FIG. 4. *Herberta angustissima: a.* portion of a plant, x 15; *b.* leaf, x 45; *c.* underleaf, x 45; *d.* basal leaf cells, x 550; *e.* apical leaf cells, x 550.

excurrent; leaf cells moderately verruculose, thin-walled with large nodular trigones and occasional intermediate thickenings about 1/3 diameter of lumen. Underleaves similar but slightly smaller and with divergent segments, 2.0 to 2.5 by 0.4 to 0.5 mm. Apparently dioicous. Female inflorescence terminal but soon innovated, with 3 to 5 whorls or involucral leaves subtending the perianth which is strongly plicate with 6 slender segments.

LUZON, Benguet, Mt. Pulog, *Burgeff 8028; Miller 10364, 10368, 10376, 10399, 10441, 10479, 10503, 10511, 10556, 10624.*

Distribution: Endemic.

HERBERTA LONGISPINA Jack and Steph. Fig. 5.

Herberta longispina Jack and Steph., Hedw., 31 (1892), 15.
Schisma longispinum (Jack and Steph.) Steph., Spec. Hepat., 4 (1909), 29.

Plants robust, erect, dark red to reddish-brown. Stem 130 by 0.2 mm, with numerous flagelliform branches. Leaves strongly secund when dry, somewhat spreading when wet, imbricate, scarcely decurrent, 3.0 to 3.5 by 0.5 to 0.6 mm, bifid about 5/6 with a broadly acute sinus and acicular segments terminating in a long, slender, hair tip, the postical segment being curved and about 1/4 larger than the straight antical one; basal disc broadly open denticulate above, becoming closer below and each bearing a slime papilla, vitta grooved, becoming bifid above mid-disc and plane near the tip; leaf cells scarcely irregular, with thick walls and small angular to nodular trigones. Underleaves similar but with straight segments, 2.5 by 0.3 to 0.4 mm. Dioicous. Male plants not seen. Female inflorescence terminal with about 3 whorls of subfloral bracts and bracteoles subtending a large 3-angled but secondarily plicate perianth which is excised about 1/2 into 6, nearly equal, long attenuate laciniæ.

LUZON, Benguet, Mt. Pulog, *Miller 10310, 10360, 10370, 10376, 10456, 10465, 11320;* without definite locality, 1870, Wallis (type, G).

Distribution: Endemic.

In a general way, this species resembles *H. angustissima,* but careful examination shows that it differs from the latter species by having underleaves with straight segments, cells of leaf base have thick walls and smaller trigones, and the slime papillæ are sessile or only short-stalked. *H. angustissima* has underleaves with divergent segments, cells of leaf base have thin walls with large nodular trigones, and the slime papillæ are mostly long-stalked.

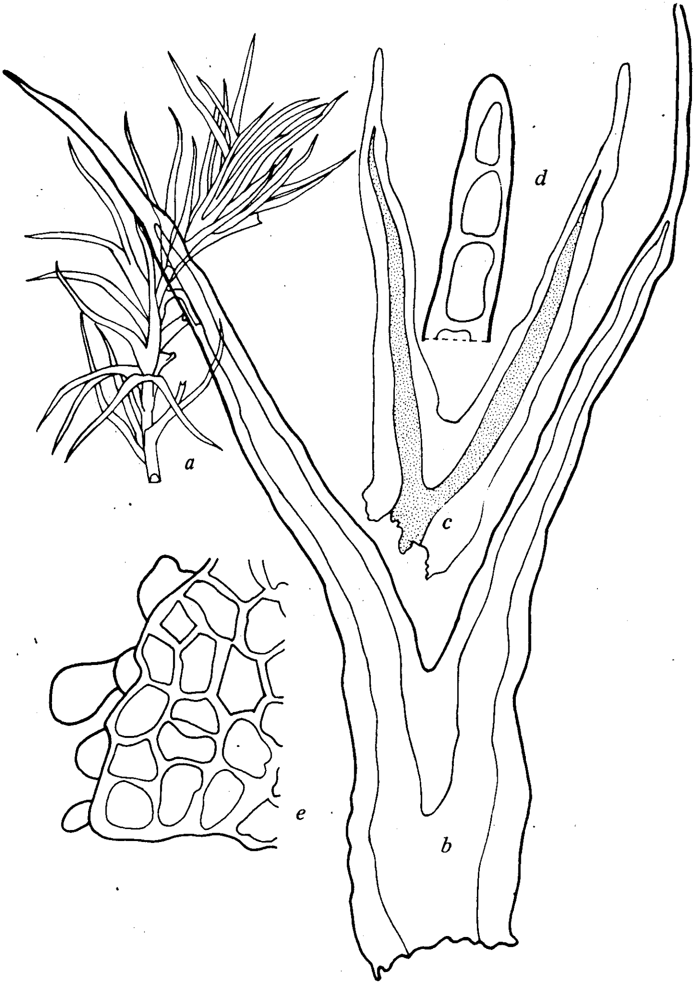

FIG. 5. *Herberta longispina: a.* portion of a plant, x 20; *b.* leaf, x 45; *c.* underleaf, x 45; *d.* apical leaf cells, x 550; *e.* basal leaf cells, x 550.

HERBERTA JAVANICA (Steph.) Miller. Fig. 6.

Schisma decurrens Steph., Spec. Hepat., 24 (1909), 24.
Herberta javanica (Steph.) Miller, J. Hattori Bot., Lab., 28 (1965), 319.

Plants rather robust, reddish-brown with numerous short, tapering, stoloniferous, ventral intercalary branches. Stem 80 by 0.35 mm. Leaves strongly falcate-secund with an inflated base, slightly decurrent, 1.5 to 2.0 by 0.7 to 1.0 mm, bifid about 2/3 with an acute sinus and lanceolate, curved segments; basal disc reniform-orbicular with nearly entire margin and a few sessile slime papillæ; vitta weak but distinct, bifid about midway in the base and soon disappearing in the segments; leaf cells verruculose with thin walls, nodular trigones larger than diameter of lumen.

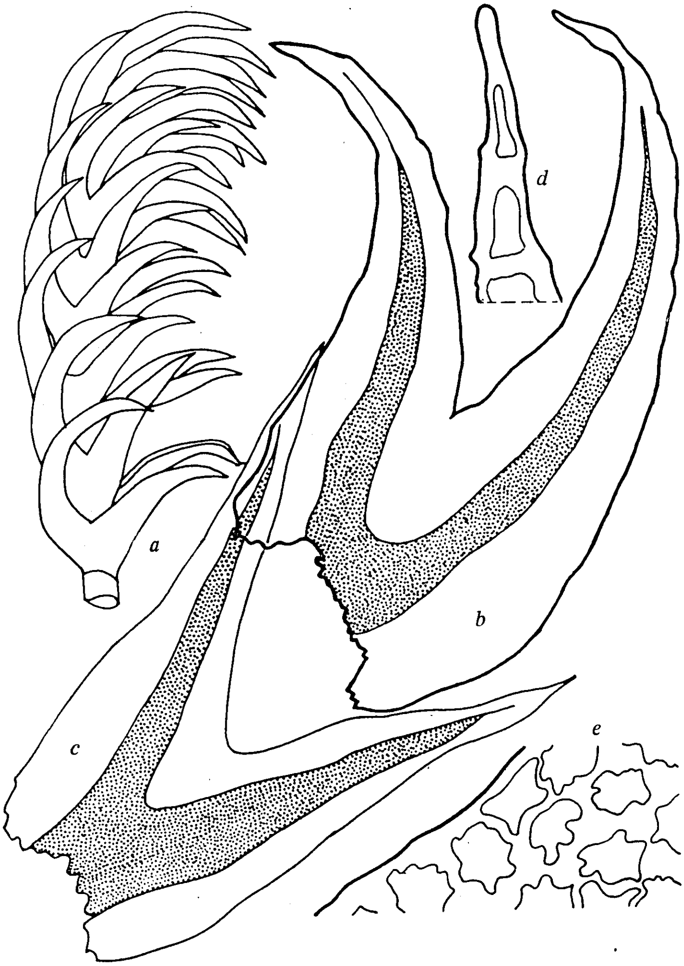

FIG. 6. *Herberta javanica: a.* portion of a plant, x 20; *b.* leaf, x 45; *c.* underleaf, x 45; *d.* apical leaf cells, x 550; *e.* basal leaf cells, x 550.

Underleaves similar but smaller, 1.0 to 1.5 by 0.5 to 0.7 mm and nearly symmetrical.

MINDANAO, Davao, Mt. Apo, *Pancho 3743, 3847, 3900.*

Distribution: Java, new to the Philippines.

By its habit, this species somewhat resembles *H. circinata,* but the leaf segments are less curved, and the leaf cells have thin walls and nodular trigones which are larger than the lumen. I have compared our plants with the type from Java and found that they resemble each other except for the vitta which is somewhat stronger in our material.

HERBERTA HANDELII Nichols. **Fig. 7.**

Herberta handelli Nichols. in Handel-Mazzetti, Symbolae, 5 (1930), 28.

Plants coarse, dark reddish-brown. Stems 60 by 0.2 mm with scattered ventral intercalary branches which are mostly flagelliform tapered but occasionally normal and forming a new axis. Leaves 1.5 to 1.7 by 0.5 to 0.7 mm, strongly imbricate, crisped, secund, broadly oblong, slightly decurrent postically, bifid about 1/2 basal disc orbicular, confluent with the segments, entire or with a few scattered short-stalked, occasionally sessile, papillæ; segments straight, acute tipped, subequal, with the antical larger; vitta distinct, rather broad, bifid about 1/3 the basal disc, deeply canaliculate-concave, disappearing beyond midsegment; leaf cells somewhat verruculose with large nodulose, sometimes confluent trigones. Underleaves similar to leaves but transversely inserted, 1.2 to 1.5 by 0.5 to 0.7 mm, straight, narrower throughout, and acuminate apically.

LUZON, Benguet, Mt. Pulog, *Miller 10578.*
Distribution: China, new to the Philippines.

The distinguishing features of this species are the concave leaves with erect segments and the narrow underleaves with segments close to each other forming a very narrow sinus.

HERBERTA FRAGILIS (Steph.) Miller. **Fig. 8.**

Schisma fragile Steph. Spec. Hepat., 6 (1922), 359.
Herberta fragilis (Steph.) Miller, J. Hattori Bot. Lab., 28 (1965), 311.

Plants yellow-brown to reddish-brown, delicate, exceptionally brittle when dry. Stem 30 by 0.1 mm, branched irregularly with both normal and microphyllous branches. Leaves 1.0 to 1.4 by 0.3 to 0.4 mm, oblong, almost transversely inserted, approximate to imbricate becoming erect-spreading when moist, nearly straight with only the tips secund, bifid 1/2 to 2/3 with an open sinus and narrowly lanceolate segments; basal disc oblong to ovate with occasional angular margins and small sessile slime papillæ; vitta narrow, shallow-grooved, bifid almost to the base and extending to just below the tip, leaf cells verruculose, thin-walled with nodular,

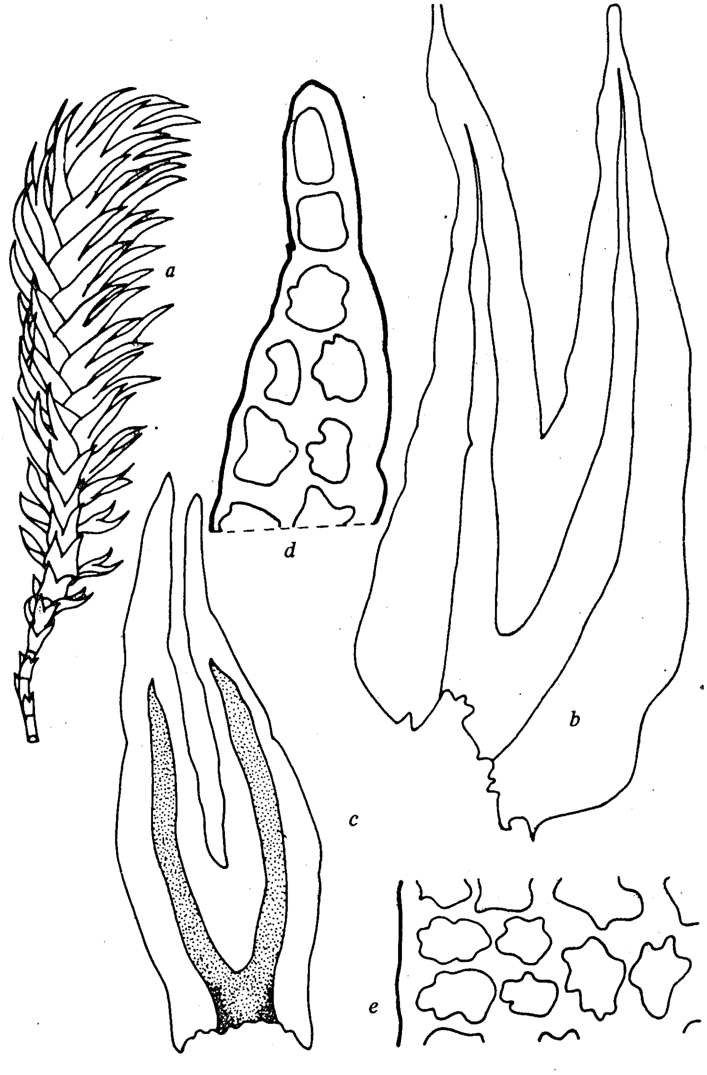

FIG. 7. *Herberta handelii: a.* portion of a plant, x 10; *b.* leaf, x 45; *c.* underleaf, x 45; *d.* apical leaf cells, x 550; *e.* basal leaf cells, x 550.

often confluent, trigones. Underleaves 0.8 to 1.0 by 0.3 mm, similar but symmetrical.

LUZON, Benguet, Mt. Pulog, *Miller 10305, 10467, 10469, 10538, 11189.*

Distribution: Himalaya, new to the Philippines.

The delicate nature of the plants, the nearly transverse insertion of leaves, the narrow vitta are the distinctive features of this species. The Philippine specimens were compared with the type.

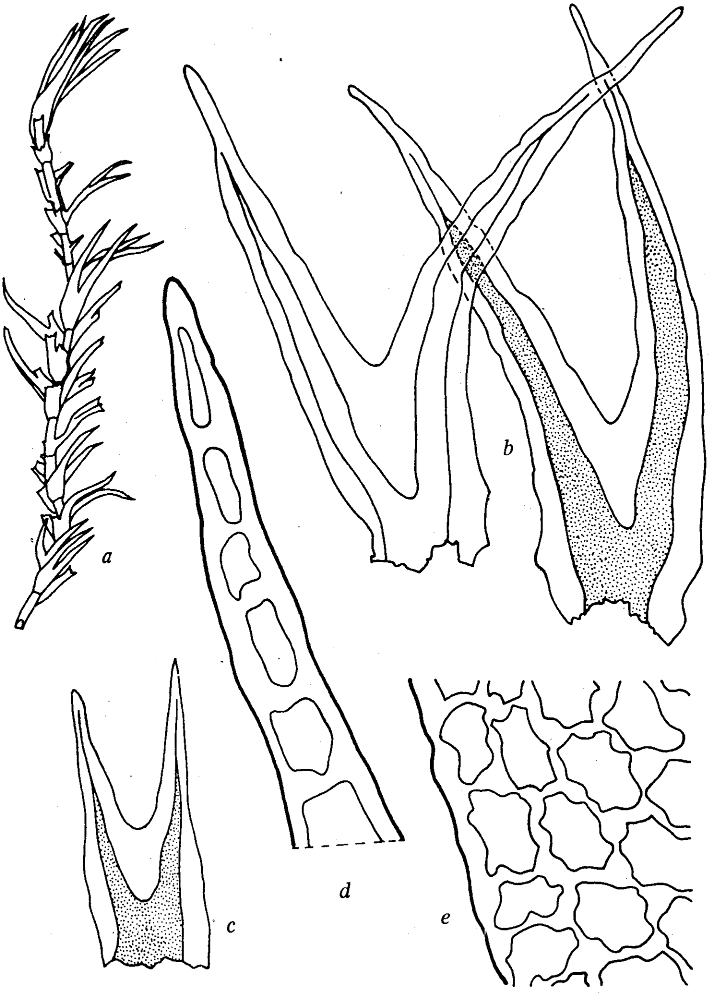

FIG. 8. *Herberta fragilis: a.* portion of a plant, x 10; *b.* leaf, x 45; *c.* underleaf, x 45; *d.* apical leaf cells, x 550; *e.* basal leaf cells, x 550.

HERBERTA DECURRENS (Steph.) Miller. Fig. 9.

Schisma decurrens Steph., Spec. Hepat., 24 (1909), 24.
Herberta decurrens (Steph.) Miller, J. Hattori Bot. Lab., 28 (1965), 317.

Plants large, wiry, dark brown. Stems 100 by 0.25 mm, sparingly branched. Leaves nearly transversely inserted, distant with reflexed-spreading, somewhat secund, segments, basal disc oblong-ovate, undulate, with some sessile and subsessile slime papillæ; 3.6 to 4.2 by 0.7 to 0.9 mm, bifid about 3/4, segments linear-lanceolate, separated by a broad sinus, circinate-reflexed, and long acuminate; vitta strong below and clasping the stem, becoming canaliculate above and extending to just below tip; leaf

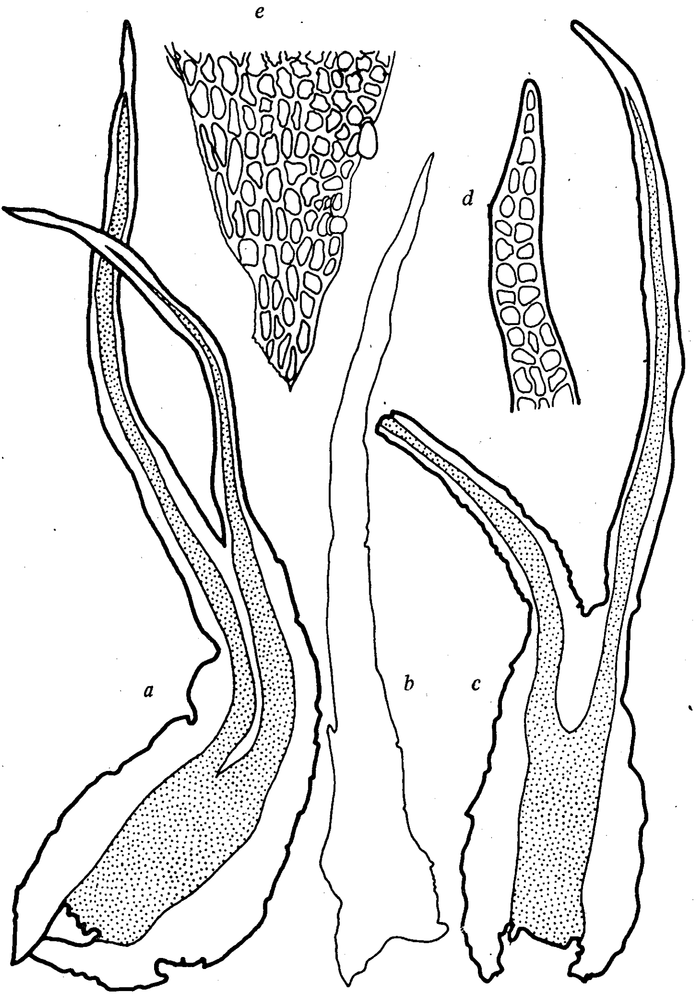

FIG. 9. *Herberta decurrens: a.* leaf, x *40; b.* antical segment, x 40; *c.* underleaf, x 40; *d.* apical leaf cells, x 150; *e.* basal leaf cells, x 150. (After Miller, 1965.)

cells with medium thick walls and nodulose trigones; striolate-papillate in the upper vitta. Underleaves similar but a little narrower, 3.5 to 3.7 by 0.6 to 0.7 mm. Dioicous. Male plants not seen. Female inflorescence terminal with about 3 whorls of little modified bracts.

LUZON, without locality, Loher (G).

No other specimens were seen other than a small portion of the type from Luzon. The species is very distinct by its transversely inserted deeply bifid ovate-oblong leaves with oblong segments that are reflexed and spreading. The leaves and underleaves are transversely inserted with the vitta clasping the stem.

HERBERTA ADUNCA (Dicks.) S.F. Gray. Fig. 10.

Jungermannia adunca Dicks., Pl. Crypt. Brit. Fasc., 3 (1793), 12.
Herberta adunca (Dicks.) S.F. Gray, Nat. Arr. Brit. Pl., 1 (1821), 705.
Herbertus aduncus S.F. Gray, Nat. Arr. Brit. Pl., 1 (1821), 705.
Schisma aduncus, (Dicks.) Dum. Comm. Bot. (1822), 116.
Sendtnera juniperina Nees in G.L.N. Syn. Hep. (1844), 239.

Plants in deep mats or pendulous, yellow-brown. Stems 100 by 0.2 mm, with scattered, long attenuate, ventral intercalary branches. Leaves more or less imbricate, erect-spreading, ovate to oblong, 1.0 to 1.6 by 0.4 to 0.6 mm, bifid 3/4 to 4/5, the postical segment falcate; vitta well-defined, slightly concave-canaliculate, and ending below the apex; basal disc orbicular and entire or with a few short-stalked papillæ; leaf cells smooth to striolate verruculose with nodulose trigones and intermediate thickenings subequal to lumen. Underleaves similar to leaves but smaller and more symmetrical; 0.9 to 1.2 by 0.3 to 0.5 mm. Male branches intercalary with bracts in 4 to 6 pairs ands shallow-lobed, bracteoles similar. Female inflorescence terminal with bracts and bracteoles similar in about three whorls and perianth typical for the genus.

MINDANAO, Davao, Mt. Apo, *Miller 10831; Pancho 3777, 3821, 3841, 3847, 9056, 9059.*

Distribution: Eastern North America, Western Europe, Japan, new to the Philippines.

This polymorphic species had been reported so far in three disjunct regions. Our specimens agree in almost all respects with specimens from the type locality in British Columbia. They were collected at high levels from 2,700 to 2,900 meters high which correspond ecologically to the cool wet forests of the Canadian

Pacific coastal mountains.

The tangled nomenclatural history of this species has been reviewed by Miller.[5)] The application of the name used here is different from that of most North American and European manuals where this species is generally called *H. hutschinsiae* or *H. tenuis* and the name *H. adunca* is applied to a very broad-leaved alpine species.

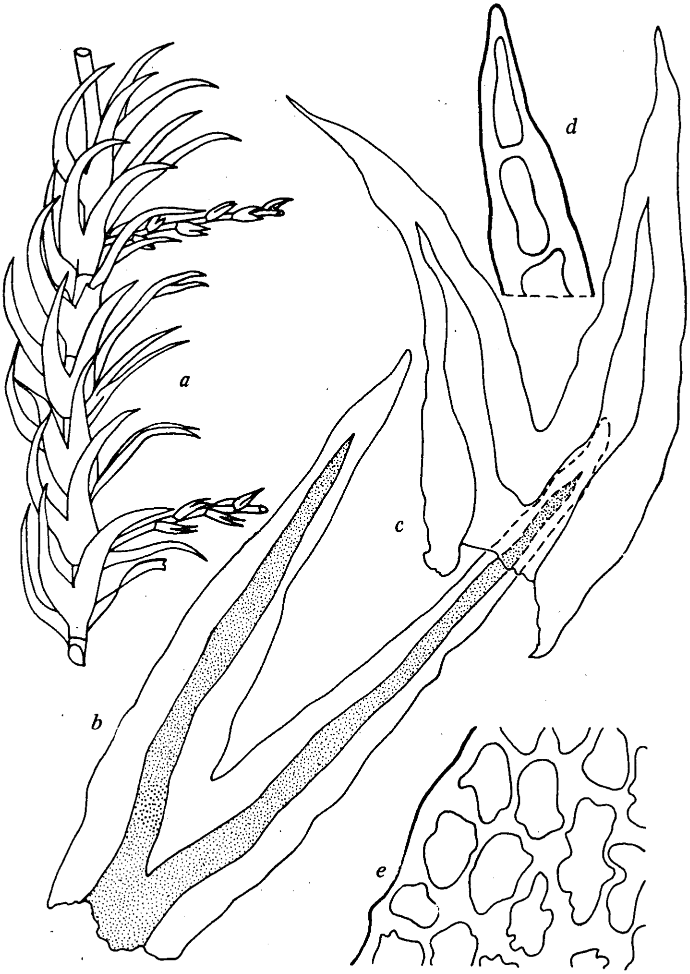

FIG. 10. *Herberta adunca: a.* portion of a plant, x 20; *b.* leaf, c. underleaf, x 45; *d.* apical leaf cells, x 550; *e.* basal leaf cells, x 550.

HERBERTA PARISSI (Steph.) Miller. Fig. 11.

Schisma parisii Steph., Spec. Hepat., 6 (1922) 361.
Herberta parisii (Steph.) Miller, J. Hattori Bot. Lab., 28 (1965), 309.

Plants long and slender, reddish brown. Stems 150 by 0.25 mm, with distinct attenuate, flagelliform branches. Leaves imbricate, almost transversely inserted, secund, shortly decurrent, 1.7 to 2.1 by 0.7 to 0.9 mm, bifid about 3/5 with a rounded acute sinus and nearly straight, lanceolate, acuminate-tipped segments, the postical being slightly larger; basal disc ovate with an undulate

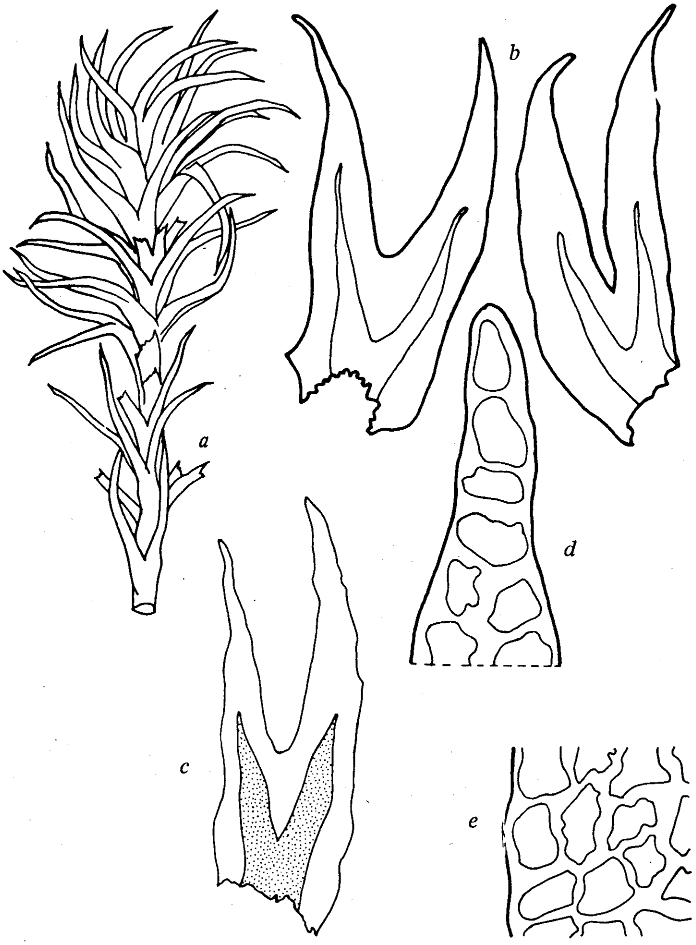

FIG. 11. *Herberta parisii: a.* portion of a plant, x 10; *b.* leaves, x 45; *c.* underleaf, x 45; *d.* apical leaf cells, x 550; *e.* basal leaf cells, x 550.

margin and few sessile slime papillæ toward the base with occasional adventitious 2 to 3-celled, stalked, slime papillæ on the decurrent base, vitta weak to indistinct, scarcely depressed, bifid from below midbase and disappearing about midsegment; leaf cells essentially smooth with thin walls and large trigones. Underleaves similar to leaves, 1.7 to 2.0 by 0.7 to 0.8 mm.

LUZON, Benguet, Mt. Pulog, *Miller 10632; Pancho 3814, 3906, 5143.*

Distribution: New Caledonia, new to the Philippines.

This species is closely related to *H. ceylanica* from Ceylon, but differs from it by its basal disc which is longer than wide, the stalked papillæ on the base, and the leaf segments which are tipped.

HERBERTA CHINENSIS Steph. **Fig. 12.**

Herberta chinensis Steph. Hedwigia, 34 (1895), 43.
Schisma chinense (Steph.) Steph., Spec. Hepat., 4 (1909), 26.

Plants robust, dark to golden-brown. Stem 150 by 0.35 mm, with numerous tapering stoloniferous ventral intercalary branches. Clusters of these stoloniferous branches develop as innovations at the site of a perianth and one continues as a new potentially reproductive axis. Leaves imbricate, with spreading tips both wet and dry, long-decurrent-clasping, ovate-oblong, 2.4 to 2.9 by 0.8 to 1.0 mm, bifid about 1/2 with an acute sinus and slightly curved segments ending in a long attenuate tip; vitta weakly canaliculate below, bifid below middle of basal disc, and extending below leaf tip; basal disc ovate, confluent with segments, nearly entire below, often ornamented with sessile and subsessile slime papillæ; leaf cells faintly verruculose, with large nodular, frequently confluent, trigones. Underleaves similar to leaves but narrower and straight, 2.1 to 2.5 by 0.6 to 0.8 mm. Dioicous. Male plants not seen. Female inflorescence terminal, the 6-laciniate perianth cleft about 1/3 and subtended by about 4 whorls of enlarged and ornamented bracts and bracteoles.

LUZON, Benguet, Mt. Pulog, *Miller 10739; Pancho 5154.*

The distinctive features of this species are the smooth curve of the antical leaf segment, the long decurrent base which is clasping the stem and the symmetrical erect underleaves. The species was first reported for the country by Inoue (1965) based on the collection of Shin from Batan Island.

HERBERTA LONGIFOLIA Horik. **Fig. 13.**

Herberta longifolia Horik., J. Sci. Hiroshima Univ. Sec. B. Div. 2, 2 (2) (1934), 208.

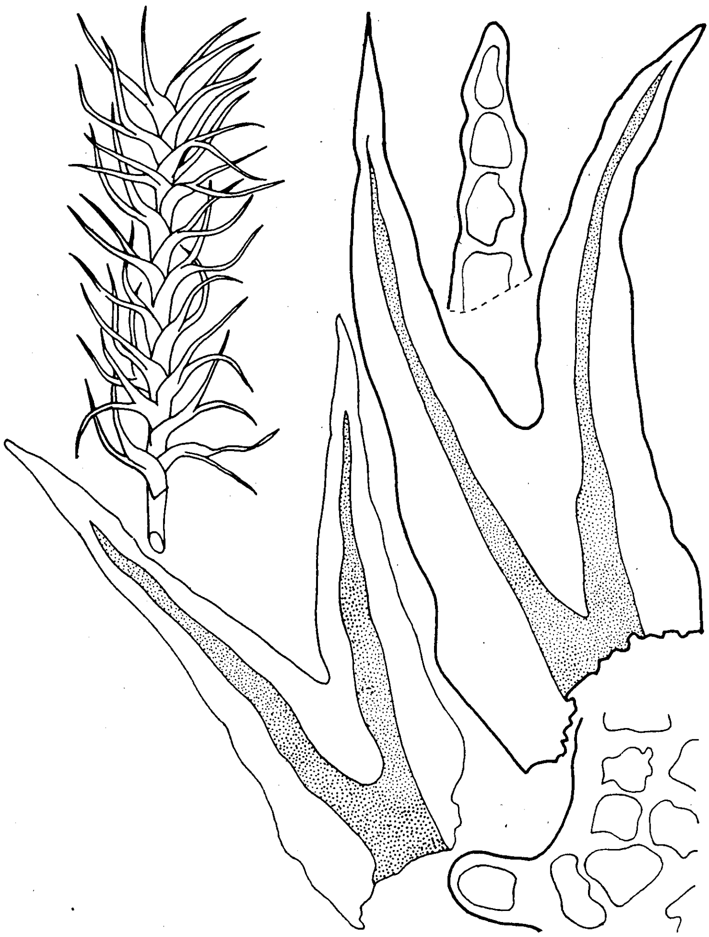

FIG. 12. *Herberta chinensis: a.* portion of a plant, x 10; *b.* leaf, x 45; *c.* underleaf, x 45; *d.* apical leaf cells, x 550; *e.* basal leaf cells, x 550.

Plants medium to large, olive-brown. Stem 40 by 0.25 mm, with scattered reduced branches, some typically leaved and others flagelliform. Leaves 2.7 to 3.0 by 0.8 to 0.9 mm, imbricate about 1/3, quite falcate-secund when dry and only a little more spreading when moist, slightly cordate decurrent, bifid 2/3 to 3/4 with an acute sinus and slightly curved subulate segments; basal disc orbicular to broadly oblong with 2 to 3 blunt teeth and a few slime papillæ near extreme base; vitta depressed, especially postically, and channelled into the segment, bifid from below mid-disc and extending to about midsegment; leaf cells verruculose, thin-walled with irregularly nodular trigones and intermediate thickenings about 1/4 the diameter of lumen. Underleaves similar but straight, segments divergent, basal disc longer and more ornamented below.

LUZON, Benguet, Mt. Pulog, *Miller 10396, 10580, 10618, 10636, 11215;* Negros Occidental, *Edano 8249.*

Distribution: Formosa, new to the Philippines.

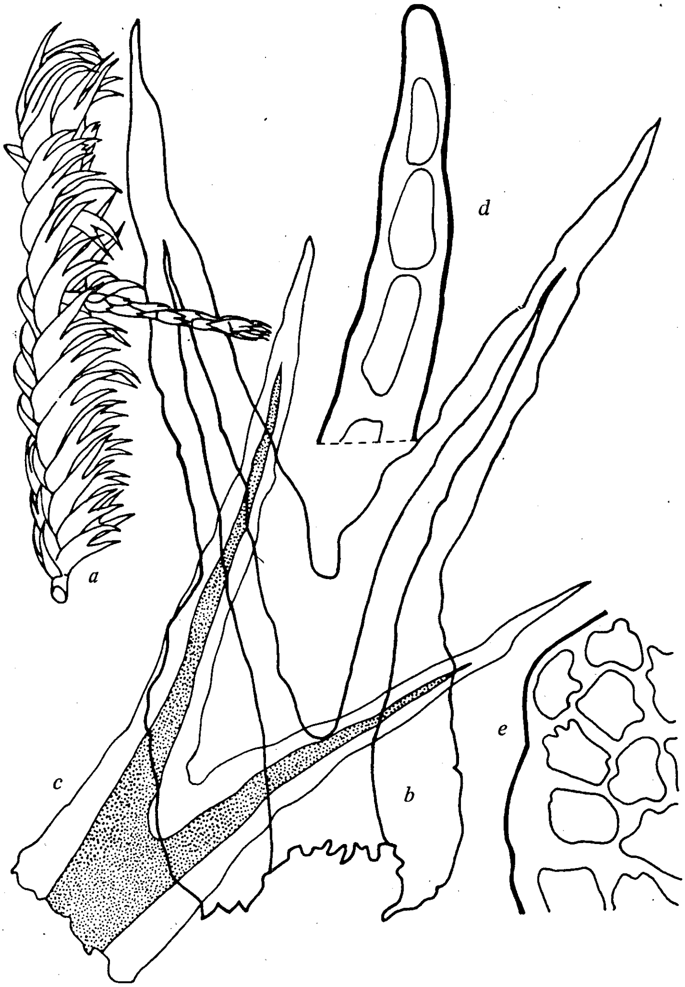

FIG. 13. *Herberta longifolia: a.* portion of a plant, x 10; *b.* leaf, x 45; *c.* underleaf, x 45; *d.* apical leaf cells, x 550; *e.* basal leaf cells, x 550.

HERBERTA MILLERIANA del Rosario. **Fig. 14.**

Herberta milleriana del Rosario, Philipp. J. Sci., 100 (1971), 297.

Plants robust, dark to golden brown. Stems 35 by 0.35 mm, with scattered ventral intercalary branches, some typically leaved and others flagelliform. Leaves 3 to 3.5 by 0.8 to 1.2 mm, imbricate, strongly falcate-secund, slightly decurrent, bifid about 1/2 with an acute sinus and lanceolate curved segments; basal disc broadly ovate-oblong to deltoid with a nearly entire margin and

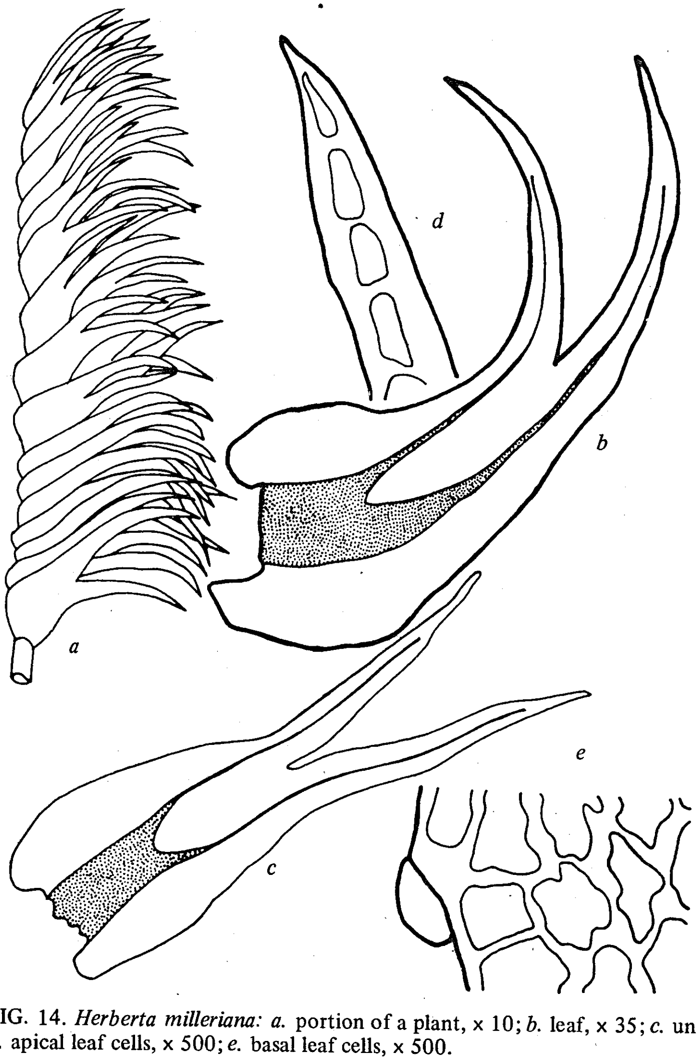

FIG. 14. *Herberta milleriana: a.* portion of a plant, x 10; *b.* leaf, x 35; *c.* underleaf, C35; *d.* apical leaf cells, x 500; *e.* basal leaf cells, x 500.

few sessile slime papillæ; vitta strong, concave, weakly canaliculate below and extending below tip; leaf cells verruculose, with large nodular trigones, 1/2 to equal or larger than lumen. Underleaves similar to leaves but straight with narrower sinus and nearly symmetrical, basal margin more undulating with mostly sessile slime papillæ. Dioicous. Male inflorescence terminal, bracts in 3 to 6 pairs, expanded at base and deeply concave but otherwise similar to leaves; bracteoles as in bracts. Female plants not seen.

LUZON, Benguet, Mt. Pulog, *Miller 10566* (type), *10442, 10468, 10564, 10581, 10674, 10707.*

The distinguishing characteristics of this species are the ovate-oblong to deltoid leaves and underleaves, their high basal discs, strongly falcate-secund leaves and their curved segments, and their leaf cells with large nodular trigones which are almost equal or even exceeding the diameter of the lumen.

The species differs from *H. chinensis* by its broadly ovate-oblong to deltoid leaves, strongly falcate-secund, little decurrent base which is not clasping, and the large nodular trigones which are not as confluent as in the latter species.

Family BLEPHAROSTOMATACEÆ

Plants small and fine, pale green, and isophyllous to moderately anisophyllous. Branching mostly terminal, lateral and ventral intercalary. Leaves transversely inserted; segments 2 to 4, each composed of a single row of short cylindrical, thick-angled cells with a single rounded-conic terminal cell, or rarely a series of very short distal cells dividing to form unicellular globular gemmæ. Underleaves slightly smaller than leaves with mostly 2 to 3 segments. Rhizoids localized at the base of underleaves. Dioicous or autoicous. Male spikes with antheridia in axils of bracts only; bracts slightly smaller than leaves, sometimes secondarily bifid; antheridia single; bracteoles lacking antheridia. Female inflorescence terminal, both bracts and bracteoles with 3 to 4 segments, each of which may be bifid or even bisbifid; perianth oblong-cylindric, rounded 3-angled above, the mouth short ciliate. Sporophyte with an elongate seta having 8 rows of epidermal and 4 rows of medullary cells. Capsule ovoid with valves 2-celled thick, outer layer with nodular thickenings in longitudinal radial walls and inner layer with near bands of thickenings, elaters bispiral; spores small, with low vermicular ridges.

Of the 4 genera belonging to the Blepharostomataceæ, only *Blepharostoma* occurs in the Philippines. The plants differ markedly from other hepatic genera by their transversely inserted leaves which are normally 4-lobed to the base, with each segment a single cell wide to the base. Occasionally 1-celled gemmæ are produced and in this respect, the family agrees with the Calypogeiaceæ.

Genus BLEPHAROSTOMA (Dum.) Dum

Blepharostoma (Dum.) Dum., Rec. d' obs. (1835), 18.

Plants small. Stems slender, with lateral branches. Leaves almost transversely inserted, divided nearly to the base into 3 to 4 capillary segments composed of a single series of cells throughout. Underleaves resembling the leaves but slightly smaller and frequently with fewer segments. Androecia spicate, terminal on branches, seldom hypogynous, bracts complicate-concave, with the laciniæ often furcate, usually monandrous. Female inflorescence terminal on the stem or branches; involucral bracts tristichous, free from the perianth, larger than the leaves, and with the laciniæ furcate or spinous; perianth oblong to cylindrical, trigonous above with the third angles postical, one layer of cells, the mouth contracted, ciliate. Capsule oval, 4-valved, of 2 layers of cells, the inner with semiannular thickenings; elaters bispiral.

BLEPHAROSTOMA TRICHOPHYLLUM (L.) Dum. Fig. 15.

Jungermannia trichophylla L., Sp. Pl (1753), 1135.
Blepharostoma trichophyllum (L.) Dum., Rec.d' obs. (1835), 11.
Ptilidium trichophylla Mitt., J. Linn. Soc. Lond., 5 (1861), 102.
Chaetopsis trichophylla Mitt., J. Linn. Soc. Lond., 8 (1865), 53.

Plants delicate, light green. Shoots with leaves to 0.7 to 0.9 μ wide by 4 to 10 mm long. Stem flexuous, filiform, sparingly branched, branches often irregular, lateral, terminal. Leaves transversely inserted, widely spreading but sometimes suberect, 3 to 4 lobed to within 0.95 the leaf length, lobes ciliumlike 8 to 15 cells long, stiff and spreading. Underleaves similar to leaves in length and size, 3 to 4-lobed on robust axes, 2 to 3-lobed on branches. Gemmæ produced by segmentation from apices of upper leaf lobes, spherical, thick-walled, pale green, smooth, from 12 to 16 to 23 μ in diameter. Mostly autoicous, more rarely paroicous or dioicous. Male inflorescence terminal or below the female inflorescence, the bracts and bracteoles similar to the leaves and underleaves, the segments often once furcate, the lamina one or two cells high and four cells across; antheridia one or two, in

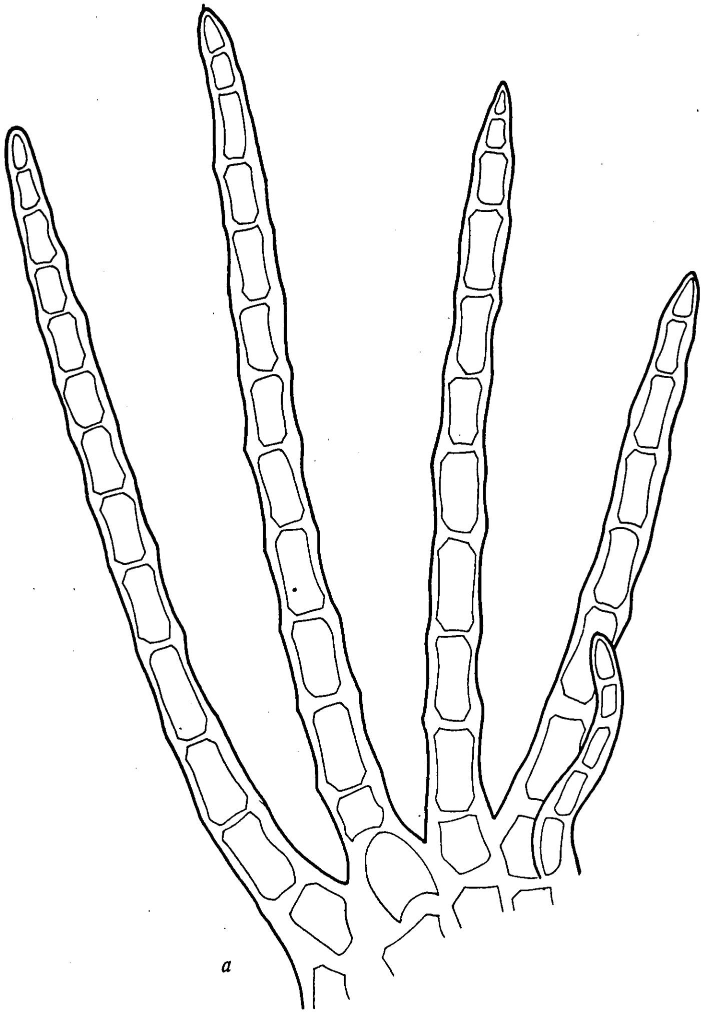

FIG. 15*a*. *Blepharostoma trichophyllum: a.* leaf, x 200.

axils of bracts, never in the bracteoles, oval to spherical, stalk uniseriate, jacket a single layer of cells. Female inflorescence terminal on main axis or a long branch, bracts and bracteoles free, larger than leaves, segments uniseriate and 1 to 3 times furcate, lamina 2 to 4 cells high and 3 cells across; perianth exserted, cylindrical, trigonous above, with one keel ventral, 2 to 3 layers of cells below, a single layer above, mouth more or less constricted, ciliate. Spores small, 8 to 10 μ in diameter, brown with groups of very fine spines; elaters about 11 μ in diameter, 130 to 300 μ long, bispiral.

LUZON, Benguet, Mt. Pulog, *Miller 10754.*

Distribution: Asia, East Africa, North and Central America, Java, new to the Philippines.

The distinctive features of this species are the uniseriate cells of leaf segments throughout their length, the single rounded conic terminal cell, the external thickening of the transverse septa, and the widely spreading segments. It may be confused with species of *Miscrolepidozia* and *Telaranea,* but both genera have leaf lobes with 2 or more layers of cells and broad at the base. The green color of the plant, varying from light-, or yellowish- to whitish-green in exposed sites, is distinctive. The verruculose cuticle is firm and rigid, and quite dull, unlike *Telaranea.*

Our material has predominantly 3-lobed lateral leaves and 2 to 3-lobed underleaves. However, the plants are relatively robust.

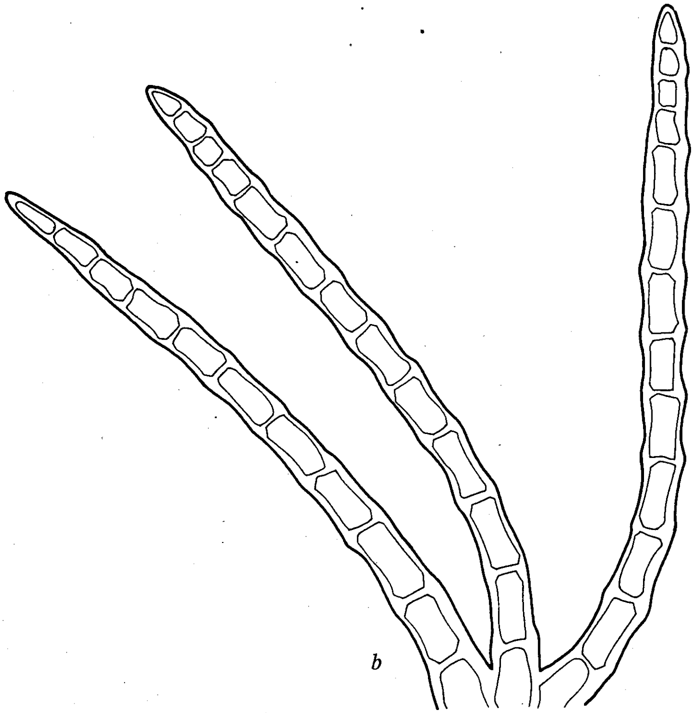

FIG. 15*b*. ***Blepharostoma trichophyllum:*** *b.* underleaf, x 200.

Family ISOTACHIDACEÆ

Plants small to robust, with leafy stems prostrate to erect, radially symmetrical to distinctly bilateral. Branches ventral intercalary, arising from axil of underleaves. Leaves transverse to obliquely incubous, rather shallowly bilobed to bisbifid into 2 to 4 unequal to subequal segments; margins entire to denticulate or coarsely dentate to ciliate. Underleaves smaller than, or nearly equal to leaves in size, bifid, margins similar to those of leaves. Dioicous. Male spikes terminal or intercalary on the main axis or a branch; bracts varying in number of pairs, similar to leaves; antheridia in pairs on stalks, 6 to 8 cells long; bracteoles similar to underleaves. Female inflorescence terminal on a main stem or branch; bracts and bracteoles in three series, similar to leaves but larger, often more deeply divided and more strongly toothed than leaves; archegonia in groups of 8 to 10; perianth much reduced, borne at the summit of a slender, hollow, conico-cylindrical, thick-walled, prolongation of stem tissue (perigynium) which encloses sporophyte, calyptra, and sterile archegonia. Capsule ovate-cylindrical, dehiscing by 4 spirally twisted valves, valves of 3 layers of cells; the outer of large cells with radially thickened walls and 2 inner layers of smaller cells with both radial and tangential thickenings; elaters long, more or less tapering at both ends; bispiral; spores small, exine smooth.

Isotachidaceæ is a family of the southern hemisphere with three genera and 34 species. *Isotachis* has a few Asian species which penetrate northward as far as Japan.

Genus ISOTACHIS Mitten

Isotachis Mitten in Hooker, Bot., Antarct. Voy. II, 2 (1845), 148.

Plants small to robust, prostrate to ascending or upright, varying from pale green, pale rose to dark red, magenta, or brown. Stems simple to irregularly branched. Leaves incubous, approximate to imbricate, spreading to appressed, oval to orbicular or occasionally reniform in outline, asymmetrical to symmetrical, bifid to bisbifid into 2 to 4 unequal to subequal segments, segments triangular in outline, margins entire to denticulate or coarsely dentate to ciliate. Underleaves smaller than or nearly equal to leaves, approximate to imbricate, appressed to spreading, occasionally reflexed, transverse, symmetrical, never connate with the leaves, bifid, margins similar to leaves. Dioicous. Male inflorescence terminal or intercalary on stem or branch; bracts in varying number of series; antheridia large, ovoid to globose, usually borne in pairs in stalks 6 to 8 cells long in the axil of bracts; bracteoles similar to underleaves. Female inflorescence terminal on stem or branch; bracts and bracteoles in 3 series, symmetrical to subsymmetrical, similar to leaves but larger, often more ovate and more deeply divided; archegonia in groups of 8 to 10; perianth much reduced, borne at the summit of a slender, hollow conico-cylindrical, thick-walled prolongation of stem tissue (perigynium) which encloses the sporophyte; calyptra free, fleshy, of the "stem calyptra" type. Sporangium ovate-cylindrical; elaters long, bispiral, brown; spores small, brown, exine smooth.

Key to the species of Isotachis

1. Stem apex decurved; leaves with margins strongly dentate to ciliate dentate . . . . *I. armata*
1. Stem apex not decurved, leaves with margin nearly entire to sparingly toothed . . . . *I. japonica*

ISOTACHIS ARMATA (Nees) Gott. Fig. 16.

Jungermannia armata Nees in G.L.N. Syn. Hepat. (1844), 129.
Isotachis armata (Nees) Gott., Ann. Sci. Nat. Bot. Ser. 5, 1 (1864), 121.

Plants medium, reddish green to dark red, simple to occasionally branched. Stem with leaves 10 cm long and 1.5 mm wide. Leaves imbricate, appressed, usually concave, asymmetrical, broadly ovate to orbicular, 2 mm long, 2 mm wide, usually bisbifid to 1/5, segments triangular in outline, apices acute, dorsal margin of lamina usually strongly convex to nearly straight, dentate to ciliate-dentate, rounded to slightly narrowed to base. Underleaves appressed to slightly spreading, 0.8 to 1.5 mm wide, bifid to 1/5, segments acute, margins strongly dentate to ciliate-dentate, lamina rounded or slightly narrowed to base. Male inflorescence not seen. Female inflorescence terminal, bracts and bracteoles similar to leaves and underleaves, but larger, perigynium conico-cylindrical, 5 to 6 mm long, arcuate. Sporophyte not seen.

NEGROS, *Merril 6838 (NY)*

Distribution: Java, New Guinea, Philippines, Sumatra.

ISOTACHIS JAPONICA Steph. Fig. 17.

Isotachis japonica Steph., Spec. Hepat., 3 (1909), 652.
Isotachis turgida Herzog, Ann. Bryol., 5 (1932), 652.

Plants medium to large, pale green to rose or bright red. Stem with leaves 6 to 12 cm long, 3 mm wide, sparingly branched.

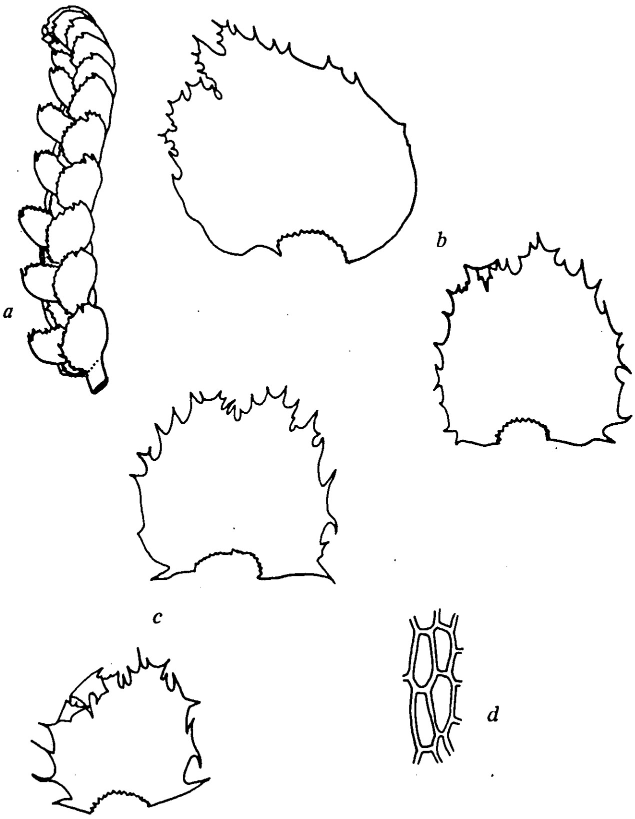

FIG. 16. *Isotachis armata*: *a.* portion of a plant, x 15; *b.* leaves, x 30; *c.* underleaves, x 30; *d.* laminal cells, x 260. (After Hatcher, 1961.)

Leaves imbricated, spreading, often curved toward ventral side, asymmetrical, ovate, 2 mm long, 1.8 mm wide, bifid to bisbifid, segments triangular, apices acute to acuminate, dorsal margin of lamina more or less broadly convex, entire or with one to a few short teeth, ventral margin strongly convex to nearly straight, entire or with teeth, more or less developed, median cells averaging 92 μ long, 24 μ wide, trigones inconspicuous to absent. Underleaves imbricate, appressed to slightly reflexed, symmetrical, ovate to orbicular, bifid, segments triangular, apices acute, margins sparingly to strongly toothed. Male inflorescence not seen. Female inflorescence with bracts and bracteoles similar to leaves and underleaves but larger, bracts asymmetrical to subsymmetrical, those of the larger series are 2.5 mm long and 2.0 mm wide, bisbifid, more or less strongly toothed as leaves, bracteole symmetrical, bifid and toothed as underleaves; perigynium 5 to 6 mm long, arcuate. Elaters bispiral, tapering slightly at both ends, averaging 300 μ long, 16 μ in diameter; spores brown, smooth, averaging 12 μ in diameter.

LUZON, Benguet, Mt. Pulog, *Miller 10725, 10749, 10754.*
Distribution: Formosa, Japan, Philippines.

The leaf margins of this species are nearly entire as contrasted to *I. armata* which has leaf margins that are strongly dentate to ciliate-dentate. The segment margins, however, may be more or less strongly toothed. The underleaves are ovate to orbicular with a few weak teeth on margins.

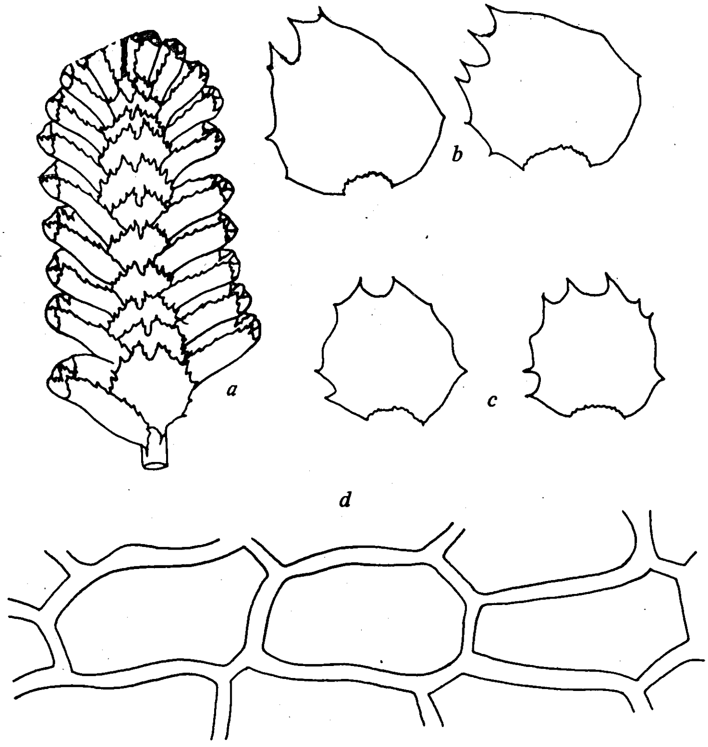

FIG. 17. *Isotachis japonica: a.* portion of a plant, x 15; *b.* leaves, x 30; *c.* underleaves, x 30; (after Hatcher 1961), *d.* laminal cells; x 550.

Suborder 2. PTILIDIINEÆ

Plants medium to large, approaching isophylly; leaves incubously inserted and oriented. Branching normally copious, 1 to 3 pinnate usually terminal and of the *Frullania* type; usually without intercalary branching; stolons or flagella absent. Leaves essentially quadrifid, margins of lobes mostly ciliate or compound ciliate. Underleaves 2- to 4-lobed, large, with margins similar to those of leaves. Rhizoids rare, only at underleaf bases. Dioicous. Male inflorescence little differentiated. Female inflorescence usually terminal with either a cœlocaule or perianth. Sporophyte large; capsule spherical to ovoid, with straight 4 to 8 stratose valves.

Key to the families of Ptilidiineæ

1. Plants reddish brown or brownish; leaves asymmetrically 2- to 5-lobed, dorsal lobe larger than the others; leaves incubous, imbricate; leaf cells with coarse trigones; perianth present .... Ptilidiaceæ
1. Plants yellow-green to gray green; leaves subsymmetric or usually symmetric; leaf cells variable at angles; perianth lacking but fleshy coelocaule present 2
   2. Leaves deeply 4- to 5-lobed, lobes with branched cilia, usually succubously inserted; leaf cells with elongated rectangular cells, without trigones; cuticle striolate .... Trichocoleaceæ
   2. Leaves deeply bisbifid, the lobes without branched cilia; more or less transversely inserted; leaf cells isodiametric to short-oblong, collenchymatous or thick-walled; cuticle smooth or papillose . .Lepicoleaceæ

Family PTILIDIACEÆ

Plants medium to large, golden brown, with either prostrate or suberect leafy stems or becoming pendulous (*Mastigophora*). Branches regularly pinnate, uniformly lateral, terminal, of the *Frullania* type. Stem terete, lacking paraphyllia. Leaf insertion slightly to obviously incubous. Stem leaves 3- to 6-lobed, asymmetric, with dorsal lobe usually longer and broader, leaf margins more or less ciliate. Underleaves similar but somewhat smaller, often with fewer lobes, occasionally with a few rhizoids at bases of underleaves. Cells very strongly collenchymatous, developing coarse to nodulose trigones. Dioicous. Male inflorescence on lateral branches becoming intercalary, bracts similar to leaves, concave at base and bearing 1 to 3 antheridia; paraphyllia sometimes present. Female inflorescence terminal on main stem or short lateral branches, bearing a true unistratose perianth, cylindrical to ovoid, more or less plicate above. Sporophyte with a spheroid capsule with 4 straight valves, usually 4 to 5 cell layers thick.

The family includes three small genera, of which only *Mastigophora* occurs locally. The group differs from Trichocoleaceæ in the collenchymatous smooth leaf cells and the strongly pigmented plants. The Trichocoleaceæ are pale-whitish green plants. In addition, the Ptilidiaceæ have perianths, while the Trichocoleaceæ lack them, and they have developed a fleshy perigynium.

Genus MASTIGOPHORA Nees

Mastigophora Nees, Naturg. Eur. Leberm., 3 (1838), 89.

Plants large, reddish brown. Stems pinnate and frequently bipinnate, branches lateral, apices frequently attenuate and flagelliferous. Leaves incubous, complicate-concave, 2- to 4-lobed, spinose dentate to entire. Underleaves large but smaller than leaves, 2- to 4-lobed, spinous dentate. Dioicous. Androecia on short attenuate branches; bracts consisting of a few pairs, complicate-concave, 2- to 3-lobed; bracteoles also with antheridia; antheridia 2 to 3. Perianth terminal on a short lateral branch, free, inflated, irregularly carinate, mouth contracted, multifid, calyptra delicate, free.

Key to the species of Mastigophora

1. Plants small, slender, leaves with straight apices, cuspidate, postical lobe of stem-leaves not pluricaciniate .... *M. gracillima*
1. Plants large, robust, leaves with recurved apices, acute, postical lobe of stem-leaves plurilaciniate .... *M. diclados*

MASTIGOPHORA GRACILLIMA Steph.

Fig. 18.

Mastigophora gracillima Steph., Spec. Hepat., 6 (1922), 366.

Plants small, slender, rigid, light brown, dark-colored when young. Stem reaching 4 cm long, regularly bipinnate, primary branches 2 to 15 mm long. Stem leaves contiguous to imbricate, spreading, 3-lobed, lobes incurved, strongly divergent, antical lobes broadly lanceolate, 0.78 mm long, cuspidate, the rest becoming shorter and narrower, extreme postical lobe sometimes also appendiculate. Upper leaf cells 31 by 25 μ, basal cells 28 by 20 μ, thick-walled with nodulose trigones. Branch leaves ovate, 0.65 mm long, 0.5 mm wide, deeply lobed, sinus obtuse, lobes straight, lanceolate, entire, postical base narrowly and longly appendiculate

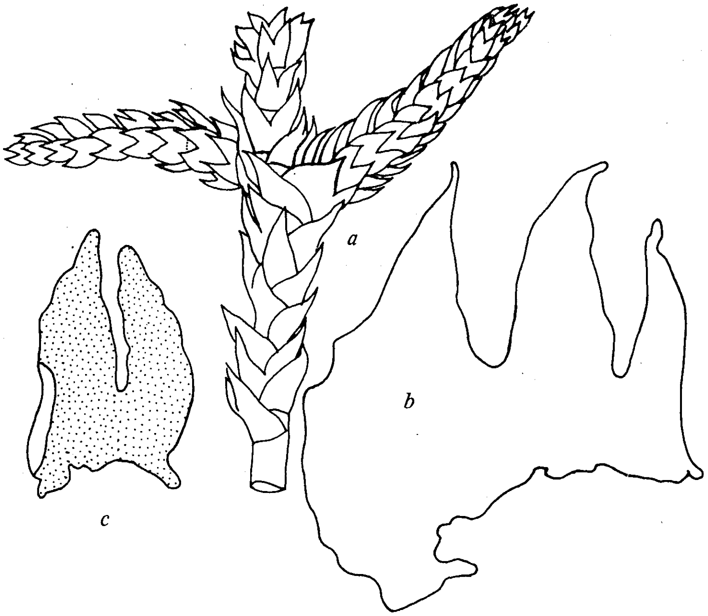

FIG. 18. *Mastigophora gracillima: a.* portion of a plant, x 15; *b.* leaf, x 45; *c.* underleaf, x 45.

on both sides. Stem underleaves similar to branch leaves. Androecia in terminal branches; bracts 3 to 6 pairs, large, with upper ones smaller.

LUZON: Without definite locality, Merrill, 1911 (G-14421, type): Laguna, Mt. Makiling, *Merril, Bur. Sc. 17154 (G) 11063.* Negros Oriental, Dumaguete, *Elmer 10195 (G).*

Distribution: Endemic.

This species is not as common as *M. diclados.* It differs markedly from the latter by its small size, cuspidate leaf lobes, and the antical lobes not being plurilaciniate.

MASTIGOPHORA DICLADOS (Brid.) Nees. Fig. 19.

Jungermannia diclados Brid. ex. Weber, Hist. Musc. Hepat. Prodr. (1815), 56.
Mastigophora diclados (Brid.) Nees. in G.L.N. Syn. Hepat. (1845), 241.
Sendtnera diclados Endl. in G.L.N. Syn. Hepat. (1845), 241.
Jungermannia subaequifolia Nees and Mont. in G.L.N. Syn. Hepat. (1845), 243.
S. fornicata Endl. in G.L.N. Syn. Hepat. (1845), 243.
S. fissa Nees in G.L.N. Syn. Hepat. (1845), 243.
S. leioclada Hook, f. and Tayl. in G.L.N. Syn. Hepat. (1847), 723.
Jungermannia leioclada Tayl., London J. Bot., 5 (1847), 85.
Sendtnera mascarenica Mitt., Trans. Linn. Soc. Bot., 5 (1861), 102.

Plants large to very large, rigid, delicate, reddish brown to more or less dark brown to black. Stem reaching 17 cm long, primary branches distant, elongate, few-pinnate; branches with small leaves, more or less long, capillaceous. Stem leaves imbricate, transversely inserted, concave, appressed to stem, with recurved apices, mature leaves trilobed to the middle, lobes erect, spreading with narrow obtuse sinus, unequal, acute, antical larger, base appendiculate, postical plurilaciniate. Branch leaves small, bilobed,

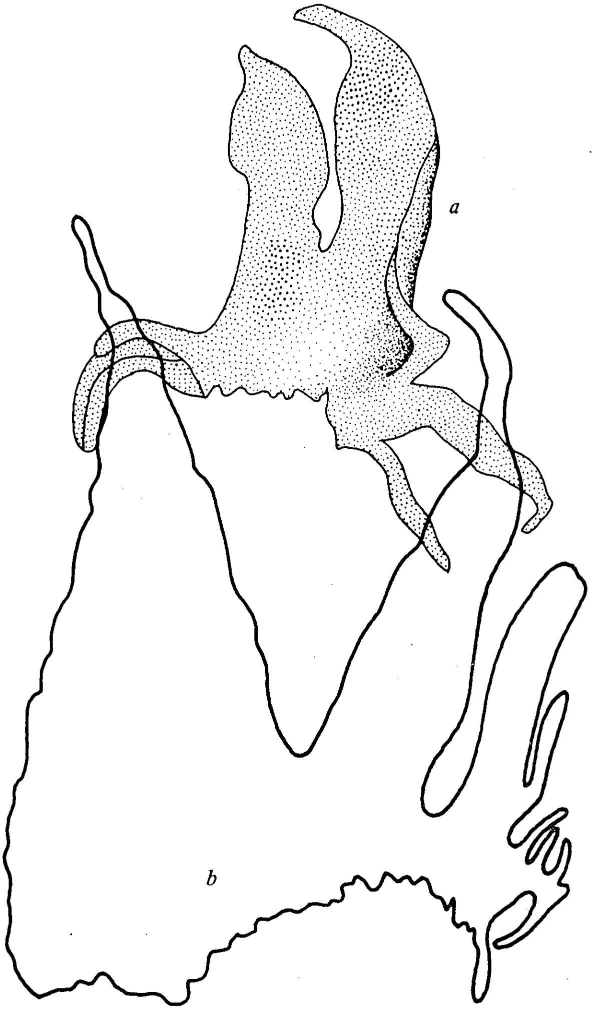

FIG. 19. *Mastigophora diclados: a.* underleaf, x 45; *b.* stem leaf, x 45.

lobes more or less equal, base similarly appendiculate. Upper cells 31 by 22 μ, basal cells 31 by 32 μ, thick-walled with nodulose trigones, papillose. Stem underleaves imbricate, appressed, oblong, base appendiculate, bilobed to the middle, lobes narrowly lanceolate, acute to obtuse. Branch underleaves deeply bilobed, lobes becoming narrow. Female branches short, terminal; perianth large, inflated to variously plicate, ovate-oblong, apex 6- to 8-lobed, lobes long and greatly filiform, straight or variously curved, fragile; capsule irregularly dehiscing.

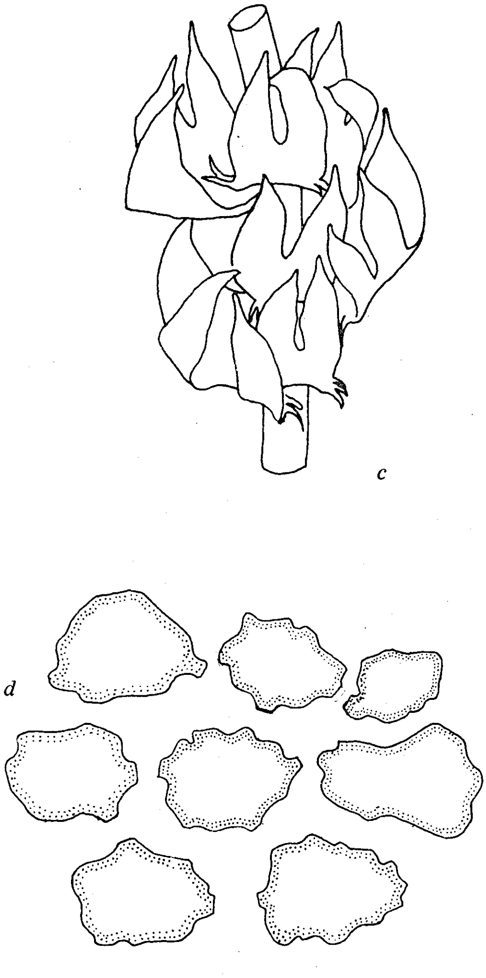

FIG. 19. *Mastigophora diclados: c.* portion of a plant, x 40; *d.* middle leaf cells, x 550.

LUZON, Pampanga, Mt. Pinatubo, *Elmer 22386;* Laguna, Mt. Makiling, Robinson and Brown, 1913, *Banaag 5, 6, Bengson 1;* Benguet, Mt. Pulog, *Miller 10270, 10441, 10490, 10708, Pancho 5023, 5093, 5345;* MINDORO, Mt. Ilong, *Edano 332;* Negros Occidental, Mt. Canlaon, *Edano 8129;* MINDANAO, Davao, Mt. Apo, *Miller 10777, 10829, 10864, 10800, 10832, 10990, 11165, 11172, 11249, 11274, 11319; Pancho 3761, 3781, 3810, 3813, 3228.*

Distribution: Africa, Asia.

There are specimens in the Philippine National Herbarium which had been labeled as *Mastigophora aequifolia* (Robinson and Brown, 1913, Robinson, 1913, *Elmer 14105*). I examined them and found them to be *M. diclados.* The plants have leaves 3-lobed instead of 2-lobed, and the lobes are narrowly lanceolate instead of being triangulate.

M. aequifolia is, therefore, at the present time a doubtful record for the Philippines, and if distinct, it is apprently limited to Ceylon and as far as Sumatra.

Family LEPICOLEACEAE

A monogeneric family with characters of the genus.

Genus LEPICOLEA Dum.

Lepicolea Dum., Rec.d' obs. (1835), 20.

Plants large and coarse, pale green to golden brown, becoming dark with age. Stem reaching 14 cm long, with leaves 0.5 to 2.0 mm broad, regularly pinnate or bipinnate, branches becoming flagelliform and microphyllous; paraphyllia sometimes present on stems and branches. Stem leaves incubous, large, attenuate, imbricate, trifid or quadrifid (rarely bifid or 5-parted), segments linear-lanceolate with entire to ciliate margins, tips hyaline or opaque, vitta sometimes present or suggested by a row of cells. Underleaves similar to leaves but usually symmetrical, lateral margins often ciliate: branch underleaves similar but smaller. Dioicous or monoicous. Male spike terminal or intercalary, bracts 2 to 30 or more in pairs, each subtending 1 to 2 globose antheridia on long stalks; bracteoles plane. Female inflorescence terminal on a main axis, axis with 1 to 3 innovations; bracts and bracteoles in several whorls becoming larger upward, innermost whorls becoming fragmented as scales on a cœlocaule; archegonia numerous among paraphyllia and paraphyses. Elaters long, slender, bi- or uni-

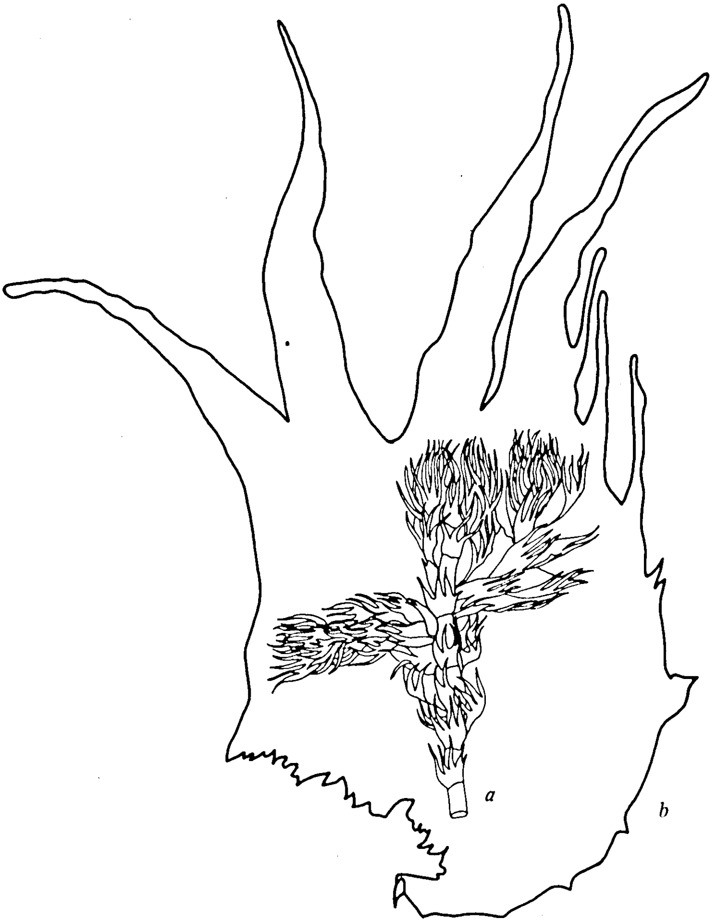

FIG. 20. *Lepicolea loriana: a.* portion of a plant, x 5; *b.* leaf, x 45.

spiral in the middle; spores reddish brown, finely or coarsely spinose.

Lepicolea with 8 to 9 species is an antarctic genus of extremely disjunct distributions.

The distinguishing features of the genus are: (*1*) nearly isophyllous plants; (2) nearly symmetrically bisbifid leaves, the median sinus of the four lobes deeper than the lateral sinuses; (*3*) perianth absent but fleshy cœlocaule present.

LEPICOLEA LORIANA Steph. Fig. 20.

Jungermannia ochroleuca β tenerior Nees, Hep. Jav. (1830), 17.
Jungermannia ochroleuca Y nana Nees, Hept. Jav. (1830), 17.
Lepicola simplicitor Herz., Ann. Bryol., 5 (1932), 81, Fig. 3c, d.
Sendtnera ochroleuca β tenerior Nees in G.L.N. Syn. Hepat. (1845), 240.
Sendtnera ochroleuca Ynana Nees in G.L.N. Syn. Hepat. (1845), 240.
Lepicolea loriana Steph., Spec. Hepat., 6 (1922), 363.

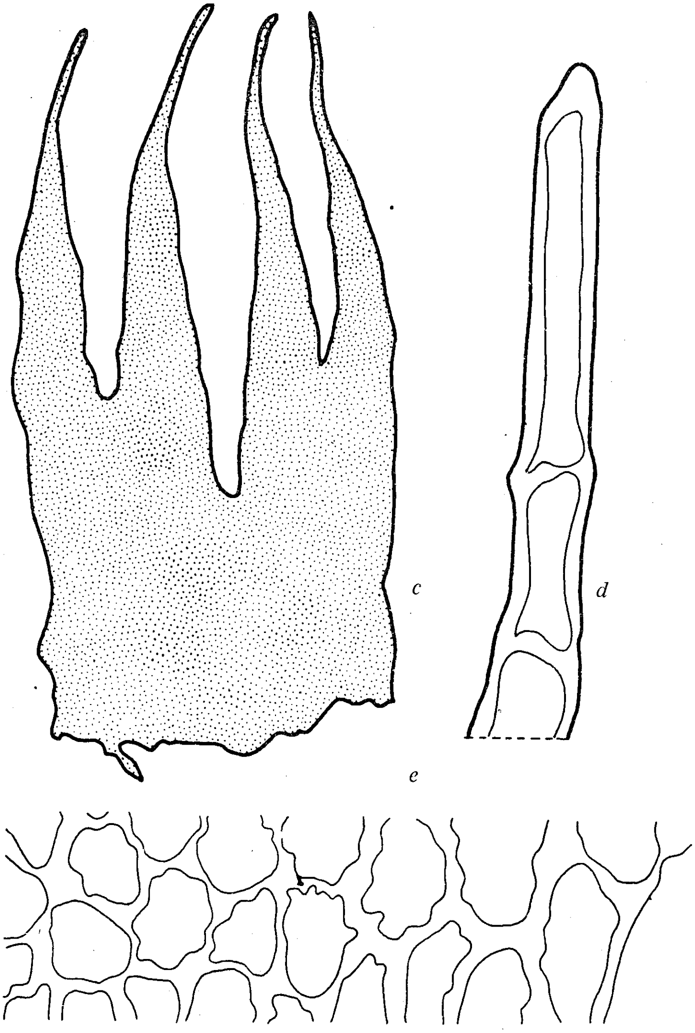

FIG. 20. *Lepicolea loriana:* *c.* underleaf, x 45; *d.* apical leaf cells, x 550; *e.* basal leaf cells, x 550.

Plants large and coarse, pale green to golden brown, becoming dark with age. Stems up to 8 cm long, 1 to 2 mm broad, with leaves; paraphyllia usually present up to 9 cells long. Stem leaves large, trifid or quadrifid (rarely bifid), asymmetrical, ovate-rectangular, nonvittate, concave, usually transversely inserted, occasionally slightly oblique, mostly 2.0 by 0.9 mm (quadrifid leaves) and 1.5 by 0.7 mm (trifid leaves), ventral side straight to slightly convex from a rounded base, margin crenulate and lacking cilia, dorsal side strongly convex from a rounded base, margin crenulate and with five or more short cilia, 1 to 5 cells long, segments long, lanceolate, attenuate, ending in a uniseriate tip to 8 cells long. Dioicous or monoicous. Male bracts usually 5 to 10 pairs or more, concave, similar to the branch leaves, cilia absent, paraphyses not seen; antheridia subglobose to globose, solitary or in pairs from axils of bracts, sometimes present in axils of bracteoles; perianth absent; archegonia in groups of 48, 54, 80 or more, neck cells mostly in rows of 20 to 26. Sporophyte enclosed in a coelocaule; elaters predominantly unispiral, spores finely spinose.

MINDANAO, Davao, Mt. Apo. *Pancho 3422, 3901, 3329;* LUZON, Benguet, Mt. Pulog, *Miller 10265, 10332, 10656, 10839;* Tayabas, *Elmer 7659* as *L. scolopendra.*

The report of *Lepicolea scolopendra* in the Philippines has been a result of misidentifications. The species differs from *L. loriana* by its more or less symmetrical and rectangular quadrifid leaves with long hyaline segment tips to 12 cells long and a prominent vitta. *L. loriana* has quadrifid and trifid (sometimes bifid) asymmetrical leaves with bulging dorsal margins and no distinct vitta. It is a very variable species and Scott 7) states that no one group of characters is consistent throughout its geographical range. The plants vary in the presence or absence of paraphyllia in stems, the amount of basal ciliation on the leaves, the number of segments of the leaves and underleaves, long versus short segment tips, and the number of cells in the uniseriate portion of the segment tip. The plants with a long segment tip may be confused with *L. scolopendra* but the cells are shorter and only one or two end cells will produce the hyaline effect, rather than the whole segment tip as in the latter species.

Family TRICHOCOLEACEAE

Plants small to robust, pale green to yellowish. Stem simple to bi- or tripinnate, branches of lateral and terminal origin. Leaves transverse to succubous, mostly 4 to 6 segmented half or more. Underleaves large, quadrifid or with additional smaller segments, often bisbifid to one-half of their length or more. Male inflorescence terminal, becoming intercalary on the stem or branch; bracts and bracteoles as leaves and underleaves, but larger or more elaborate; antheridia in bracts only. Female inflorescence terminal, sometimes once or twice innovated; bracts and bracteoles in several series, often more elaborate than leaves and underleaves. Sporophyte covered by a shoot calyptra and a perianth or a partial cœlocaule capped by a short perianth above the level of the capsule, or a thick fleshy cœlocaule covered with scales and paraphyllia, unfertilized archegonia at the tip with no indication of a perianth; capsule wall thick with 4 to 7 layers, outermost layer with large cells, inner layer with smaller cells.

The Trichocoleaceæ include 44 species in four genera. Most species are large with bi-to bitripinnately, feathery branched stems and with the leaves divided into slender capillary segments. The chief characters are: *(1)* more or less symmetrical 4- to 6-lobed leaves, usually succubous; *(2)* presence of a paraphyllose or scaly cœlocaule; *(3)* noncollenchymatous elongate cells; and *(4)* the regularly pinnate branching.

Key to the genera of Trichocoleaceæ

1. Stems sparingly and irregularly branched, brownish green; leaves more or less symmetrical, 4- to 5-lobed, divided for 0.2 to 0.25 the length of leaf, without cilia; perianth long, with three rounded keels above, surface without paraphyllia, mouth not contracted .... *Temnoma*
1. Stem distantly pinnate to closely and regularly bi- or tripinnate, light green, never pigmented with brown; leaves more or less strongly asymmetrical, 4 to 7 lobed, divided for 0.5 to 0.9 the leaf length, with cilia; perianth (if present) densely covered with paraphyllia, in some species a partial or complete cœlocaule developed .... *Trichocolea*

Genus TRICHOCOLEA Dum. corr. Nees

Trichocolea Dum. corr. Nees, Naturg. Eur. Leberm., 3 (1838).

Plants large, whitish-green to light yellow-green. Stems filiform to robust and rather fleshy, subsimple to usually 1 to 3 pinnately branched; branches all of the *Frullania* type; flagella absent; cuticle somewhat thickened and striolate; paraphyllia sometimes present. Rhizoids lacking or, when present, in tufts from bases of underleaves, more rarely from bases of male bracteoles. Leaves distant to imbricate, obtrapezoidal to subreniform, strongly succubously inserted, more or less strongly asymmetrical, 4- to 7-lobed, with ventral portion of leaf larger, sinuses descending 0.5 to 0.9 the leaf length, lamina often largely resolved into narrowly triangular lobes which end in long cilia and are sparingly to copiously armed with opposite, or sometimes verticillate, simple to branched cilia. Cells of leaf lobes, cilia and undivided basal lamina, rectangular and obviously elongate in outline, rarely subquadrate to oblong-hexagonal, thin to somewhat equally thick-walled and lacking obvious trigones; cuticle striolate-papillose. Underleaves somewhat smaller than leaves, symmetrically bifid with primary lobes again more shallowly bilobed, thus typically 4-segmented and with margins armed with cilia similar to that of leaf lobes. Dioicous. Androecia terminal on main branches; bracts similar to leaves but with lamina more extensive and lobes shorter; antheridia globose, 1 to 2 per bract. Female inflorescence terminal on the stem or less frequently through innovations, surrounded by capillary involucral leaves; perianth absent or feebly developed; calyptra erect, clavate, fleshy, being a prolongation of stem tissue surrounding embryo, covered by paraphyllia, sterile archegonia at its apex; capsule oblong, wall of 6 to 8 layers of cells.

Key to the species of Trichocolea

1. Stem with a few to many paraphyllia; leaves 6- to 8-lobed . *T. tomentella*
1. Stem without paraphyllia 2
    2. Leaf lamina up to 15 cells high; 5-lobed; ciliate segments forked. *T. merrillana*
    2. Leaf lamina up to 5 cells high, mostly 4-lobed; ciliate segments simple or variously branched 3
3. Leaves symmetrical 4
3. Leaves asymmetrical 5
    4. Leaves 5-lobed; all ciliate segments simple. . . . . *T. striolata*
    4. Leaves 4-lobed; ciliate segments branched
5. Plants not delicate; leaves 4-lobed 6
5. Plants weak or delicate; leaves bisbifid or 5-lobed 7
    6. Leaves subquadrate, often obcuneate; ciliate segments 2- to 3-paired, branched; leaf lamina up to 8 cells high . . . . *T. obconica*
    6. Leaves oblique truncate; delicate segments 4-paired; leaf lamina 3 to 4 cells high . . . . *T. obconica*
7. Stem thin; leaves bisbifid; leaf lamina 1 cell high; ciliate segments delicate. *T. fragillima*
7. Stem thick but weak; leaf lamina more than 2 cells high; leaves 5-lobed. *T. breviseta*

TRICHOCOLEA TOMENTELLA (Ehrh.) Dum. corr. Nees. **Fig. 21**

Jungermannia tomentella Ehrh., Beitr. Naturk., 2 (1788), 105.
Thricholea tomentella Dum. Comment. Bot. (1822), 113.
Tricolea tomentella Dum. Syllog. Jungerm. (1831), 99.
Tricolea tomentella Dum. Syllog. Jungerm. (1831), 167.
Tricolea tomentella Dum. Rec. d' Obs. Jungerm. (1835), 20.
Trichocolea tomentella (Ehrh.) Dum. corr. Nees, Naturg. Eur. Lebrum., 3 (1838), 105.
Tricolea biddlecomiae Austin, Bot. Gaz., 3 (1878), 6.

Plants robust, pale, whitish-green. Stem with leaves up to 2 mm wide, 5 to 10 cm long, regularly bipinnate; primary branches mostly 1 cm long; rhizoids not seen; paraphyllia abundant except on ventral side, uniseriate, 5 to 8 cells long, occasionally branched; cuticle striolate, papillose. Leaves distant to imbricate, asymmetrical, usually 1 mm long and 2 mm wide, divided nearly to the base into 6 to 8 unequal, often divided segments, segments triangular, densely ciliate with long, simple or branched, usually opposite cilia, segments and cilia curved and closely appressed to

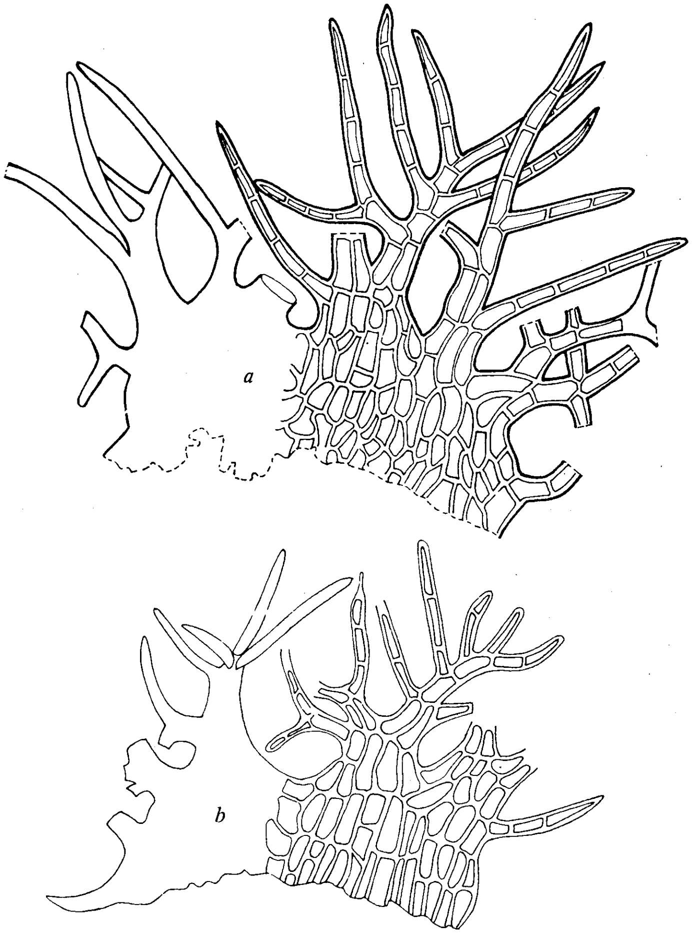

FIG. 21. *Trichocolea tomentella: a.* leaf, x 70; *b.* underleaf, x 70.

stem, lamina at most 3 cells long, cells mostly rectangular, the cuticle striolate papillose. Underleaves smaller, 1 mm long and 1 mm wide, bifid and usually deeply divided into 4 often divided segments, cilia similar to those on leaf. Branch leaves and underleaves similar to those on stem but smaller and fewer segments. Female inflorescence terminal on a main stem or branch, bracts and bracteoles in three series, innermost series largest; bracts similar to leaves but larger; bracteoles usually deeply divided into 4 segments. Sporophyte enclosed in a club-shaped cœlocaule, sporangium large, oblong; elaters reddish-brown, bispiral, spores not seen.

MINDORO, Mt. Halcon, *Edano 174, 242, 8102;* Bicol Sorsogon, Mt. Bulosan, *Edano* and *Gutierrez 269, 329;* NEGROS ORIENTAL, Mt. Malbug, *Edano 591.*

Distribution: America, Asia, Europe.

TRICHOCOLEA MERRILLANA Steph. Fig. 22.

Trichocolea merrillana Steph., Spec. Hepat., 6 (1923), 375.

Plants large, light brown, shoot apex becoming green. Stem extending to 6 cm long; branches distant, shortly pinnate, with smaller leaves. Stem leaves asymmetrical, 0.8 mm wide and at most 2 mm long; lamina widely obcuneate, reaching 9 cells high, 30 cells wide, apex obliquely truncate, divided into 5 lobes, apex of lobes trifid; cilia opposite pinnate, forked; cuticle striolate. Underleaves divided into 2 lobes; cilia forked similar to those on leaves.

LUZON, Laguna, Mt. Banahao, *Merrill 1534* (G) type Benguet, Mt. Polis, *McGregor, Bur. Sci. 19809* (G) 1913; Laguna, Mt. Banahao, Copeland, 1913 (G) *Pancho 3142, 3344;* Mt. Makiling, Robinson, 1912 (G).

Distribution: Philippines, Thailand.

TRICHOCOLEA STRIOLATA Steph. Fig. 23.

Trichocolea striolata Steph., Spec. Hepat., 4 (1909), 61.

Plants large, flaccid, pale green. Stem reaching 10 cm long, robust, naked, regularly pinnate, branches distant, lanceolate. Stem leaves small, 0.4 mm long, 0.7 mm wide, symmetrical, basal margin 2 cells high with few cilia; apex 4 to 5-fid, cilia lanceolate, opposite pinnate, 4-paired; lamina cells 22 by 55μ; cuticle striolate. Stem underleaves smaller than leaves, 4-fid; cilia as in leaves.

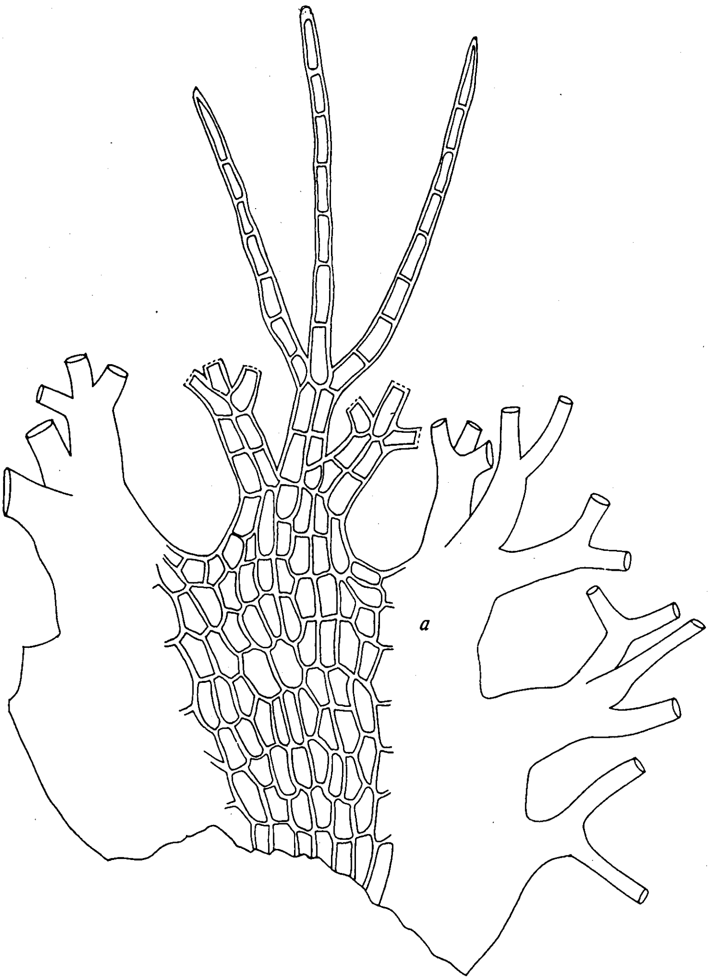

FIG. 22. *Trichocolea merrillana: a.* leaf, x 70.

LUZON, Tayabas, *Elmer 9288.*
Distribution: Endemic.

TRICHOCOLEA PLUMA (Reiniv., Bl., and Nees) Mont. **Fig. 24**

Trichocolea pluma (Reiniv., Bl., and Nees) Mont., Voy, de la Bonite, 1 (1844-1846), 238.

Plants large, flaccid, yellowish. Stem up to 12 cm long, simple or branched; branches distantly pinnate, pinnæ short and less

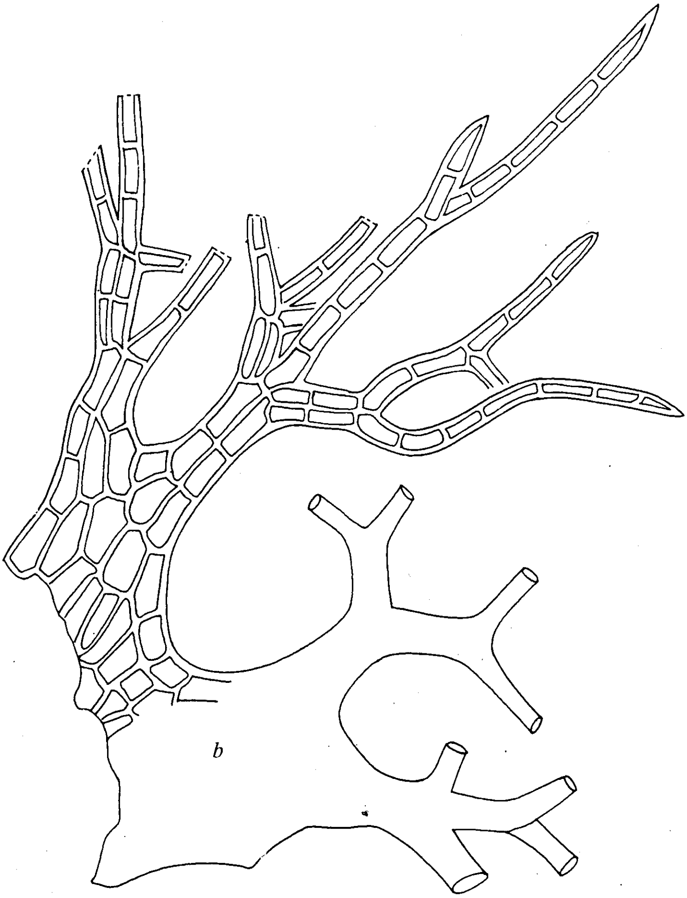

FIG. 22. *Trichocolea merrillana: b.* underleaf, x 70.

dense, plumelike. Stem leaves small, about twice as large in branches, subtransversely inserted; lamina low, one cell high; quadrifid, the segments narrowly lanceolate; cilia opposite pinnate, 5- to 6-paired, lower ones forked, upper ones simple and short; disc cells 18 by 54 μ; cuticle striolate. Stem underleaves similar to leaves but narrower and bifid. Dioicous. Female inflorescence terminal in stem or primary branches.

LUZON, Laguna, Majayjay, Curran and Merritt, 1907. NEGROS, Dumaguete, Cuernos Mts., *Elmer 9875, 10058.*

Distribution: Banca, Borneo, Ceylon, Java, New Caledonia, New Guinea, Philippines, Samoa, Tahiti, Thailand.

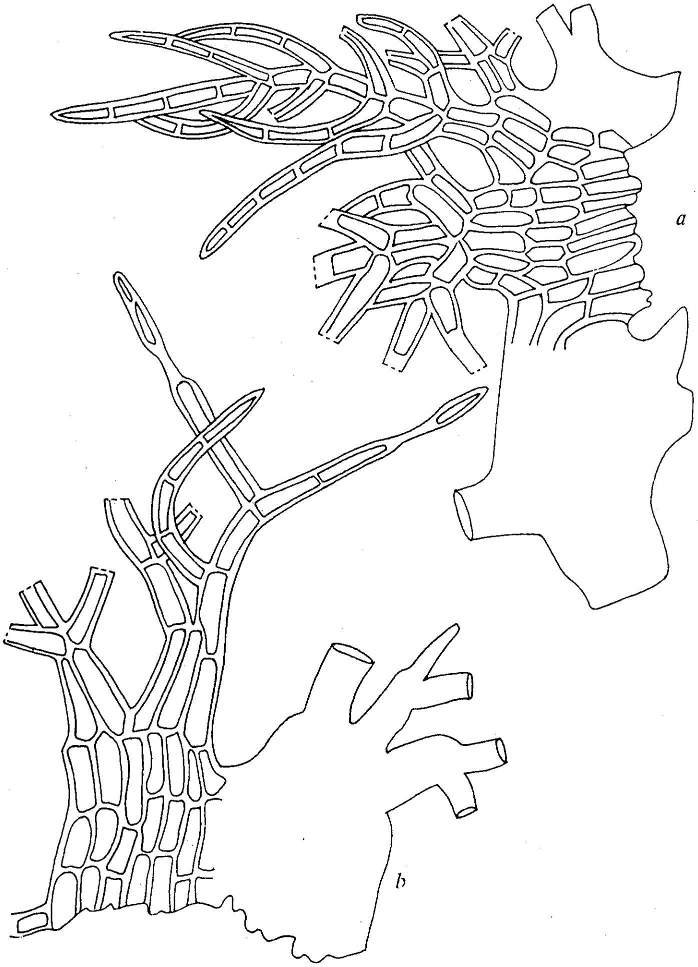

FIG. 23. *Trichocolea striolata: a.* leaf, × 70; *b.* underleaf, × 70.

TRICHOCOLEA OBCONICA Steph.

Fig. 25.

Trichocolea obconica Steph., Spec. Hepat., 6 (1923), 375.

Plants very small, flaccid, green. Stem up to 15 mm long, simple. Stem leaves distant, strongly concave, subquadrate, often narrow obcuneate, base widely inserted, apex quadrifid; cilia divergent, 1- to 2-paired, simple or forked. Stem underleaves large, twice as wide as long, connate with the leaves; cilia 1-paired.

This species was recently reported for the Philippines by Inoue[8)] based on the specimens collected by Shin in Batan Island.

Distribution: Java, Malaya, Philippines, Ponape (Caroline Islands).

TRICHOCOLEA TONKINENSIS Steph. **Fig. 26.**

Trichocolea tonkinensis Steph., Spec. Hepat., 4 (1909), 60.

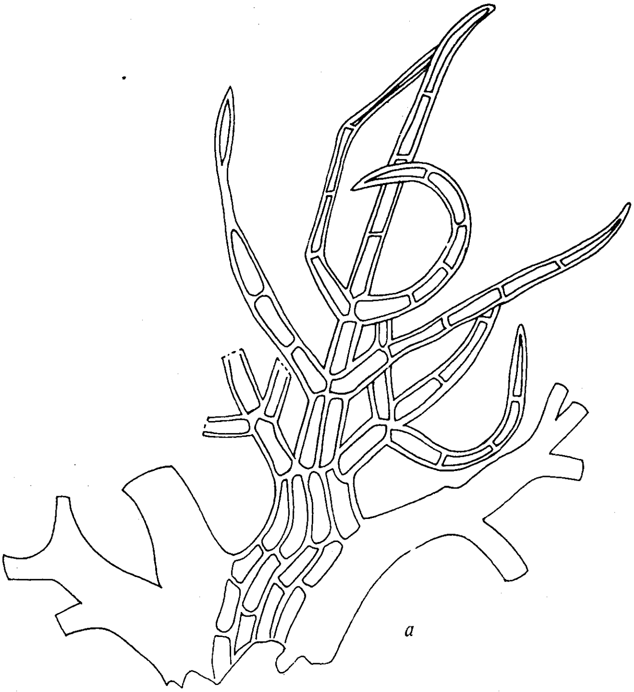

FIG. 24. *Trichocolea pluma: a.* leaf, x 70.

Plants medium-sized, flaccid, pale green. Stem up to 8 cm long, naked, bipinnately branch; branches fan-shaped. Stem leaves distant, inserted transversely, antical narrowly decurrent, irregularly ciliate; lamina 0.93 mm wide, asymmetrical, low, antical 1 cell high, postical 3 to 5 cells high, oblique truncate, apex quadrifid; lobes lanceolate, opposite pinnate; cilia 4-paired, forked irregularly; lamina cells 18 by 54 u; cuticle striolate. Stem underleaves large, basal disc 1 to 2 cells high, irregularly ciliate; apex bifid; segments shorter, 3-paired, lowest pair forked, upper ones simple and shorter.

MINDANAO, Agusan, Mt. Urdaneta, *Elmer 14205.*
Distribution: Philippines, Tonkin.

TRICHOCOLEA FRAGILLIMA Herz. **Fig. 27.**

Trichocolea fragillima Herz., Ann. Bryol., 4 (1931), 84.

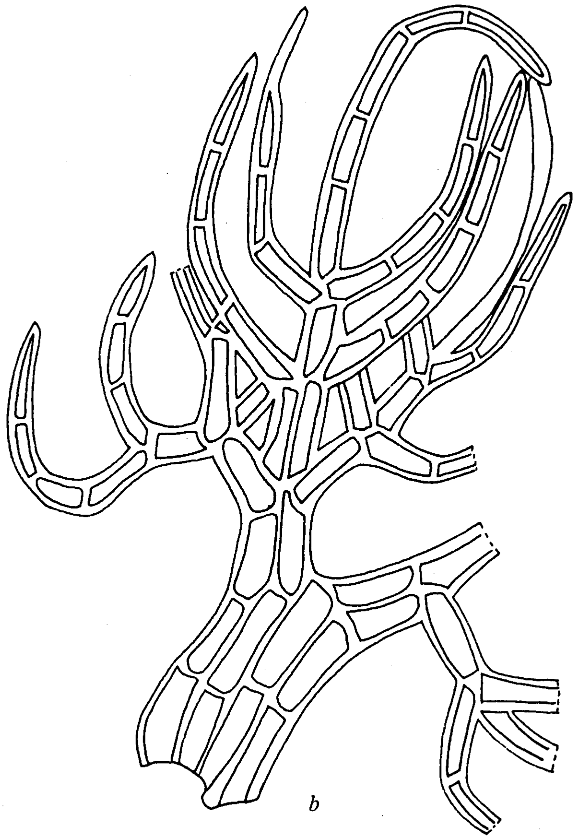

FIG. 24. *Trichocolea pluma: b.* underleaf, x 70.

Plants sterile, slender, pale green. Stem 1 to 2 cm long, flexuous, hairlike, minutely bipinnate, paraphyllia absent. Leaves subtransversely inserted, asymmetrical, about 0.4 mm long and as wide, unequally bisbifid; disc undivided, 1 cell high; antical lobe 4 cells wide, cells of lobes 0.06 mm long, 0.02 mm wide, bifid, postical lobe bifid nearly to base, bipinnate on both sides; cilia very slender and fragile, needlelike; cuticle striolate. Underleaves as large as leaves, symmetrical, bisbifid to the base, disc entire. Branch leaves and underleaves subsymmetrical, disc one cell high.

LUZON, Laguna, Mt. Makiling, *Baker 7028, 7049b.*

Distribution: Philippines, New Guinea.

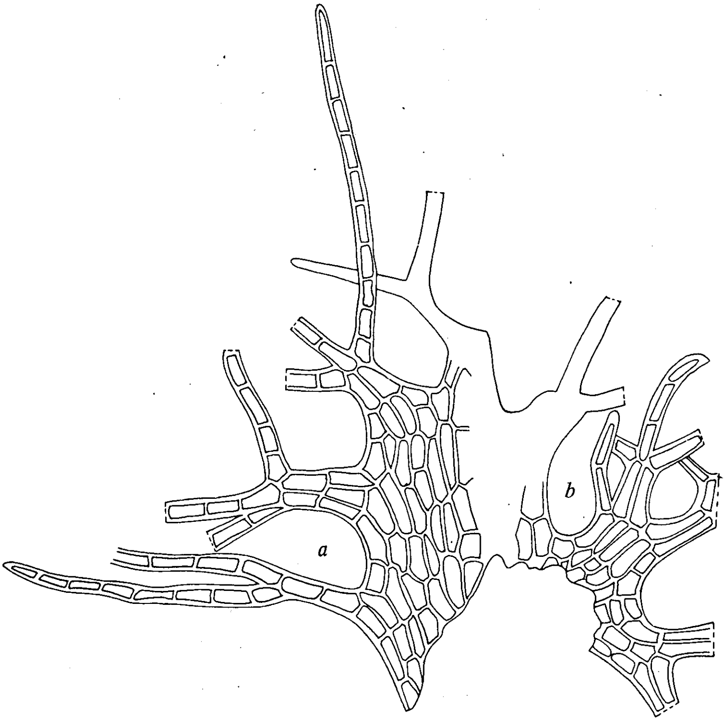

FIG. 25. *Trichocolea obconica: a.* leaf with the attached underleaf, x 70.

TRICHOCOLEA BREVISETA Steph. **Fig. 28.**

Trichocolea breviseta Steph., Spec. Hepat., 4 (1909), 60.

TRICHOCOLEA CAPILLATA (Lindb.) Steph.

Leiocolea capillata Lindb., Acta Soc. Fauna Fl. Fennica, 10 (1875), 515.
Trichocolea capillata (Lindb.) Steph., Spec. Hepat., 4 (1909), 61.

Plants sterile, flaccid, pale green. Stem to 5 cm long, thick but weak, naked; branches distant and short pinnate. Stem leaves dense, close together, spreading, antical base short decurrent, strongly asymmetrical, as broad as long; disc large, 5 to 8 cells high, up to 30 cells wide, oblique-truncate; postical 0.65 mm, antical 0.2 mm high, both irregularly bristlelike, apex 5-cleft, segments very short, cilia short, opposite pinnate in 3 pairs apex forked; laminal cells 28 by 62 μ, cuticle strongly striate. Underleaves small, obcuneate, bifid, lobes whorled, trifid; cilia short, distant, pinnate, pinnæ in 3 pairs, short.

LUZON, Laguna, Mt. Banahao, C. B. Robinson, 1910; MINDANAO, Davao, Mt. Apo, *Elmer 11370.*

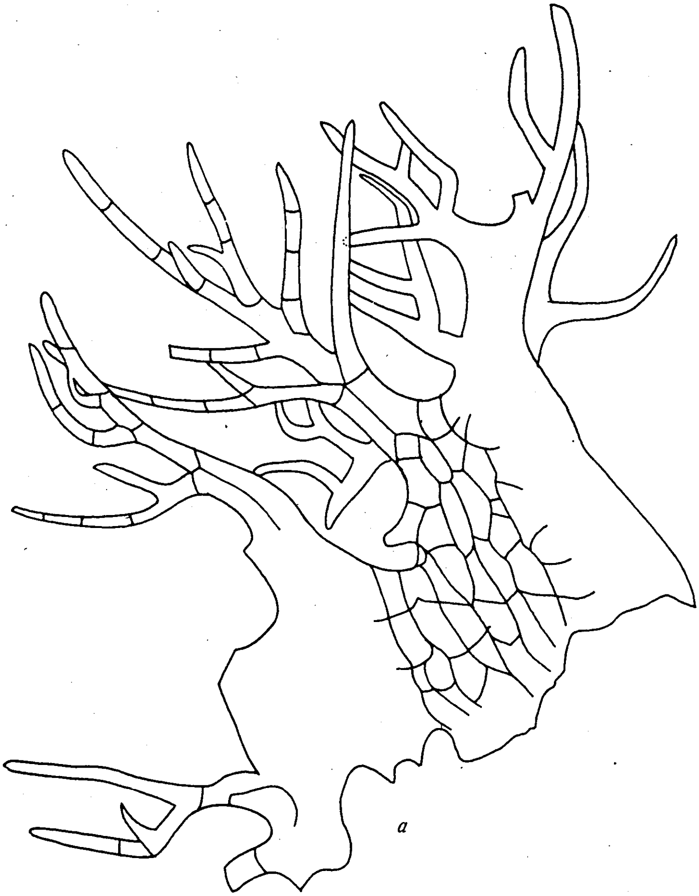

FIG. 26. *Trichocolea tonkinensis: a.* leaf, x 70.

Distribution: New Guinea, Philippines.

This species was apparently described from a Philippine collection by S.O. Lindberg in 1875. Stephani⁹⁾ copied the original description and noted that it was near *T. striolata* but apparently he did not see the plants. I have found no other records of the species and have not seen a specimen.

Genus TEMNOMA Mitt.

Temnoma Mitt. in Hook. Handb. N.Z. Fl., 2 (1867), 753.

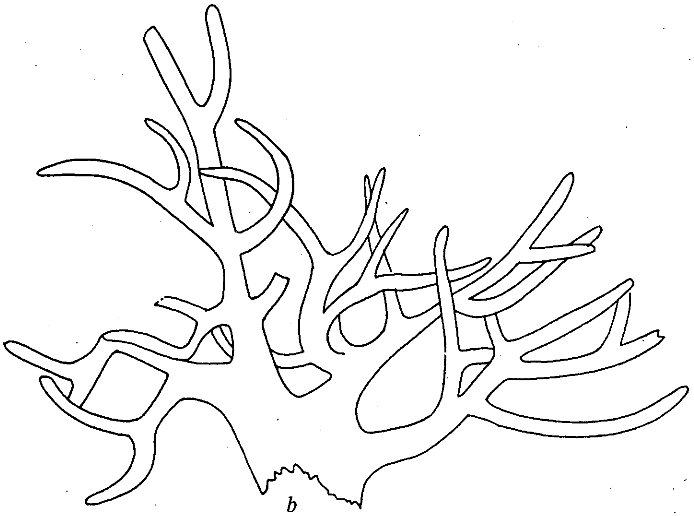

FIG. 26. *Trichocolea tonkinensis: b.* underleaf, x 70.

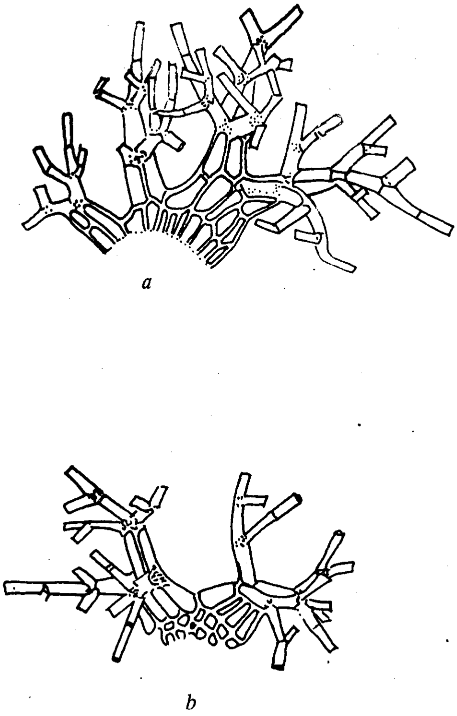

FIG. 27 *Trichocolea fragillima: a.* leaf, x 55; *b.* underleaf, x 55. (After Herzog, 1931.)

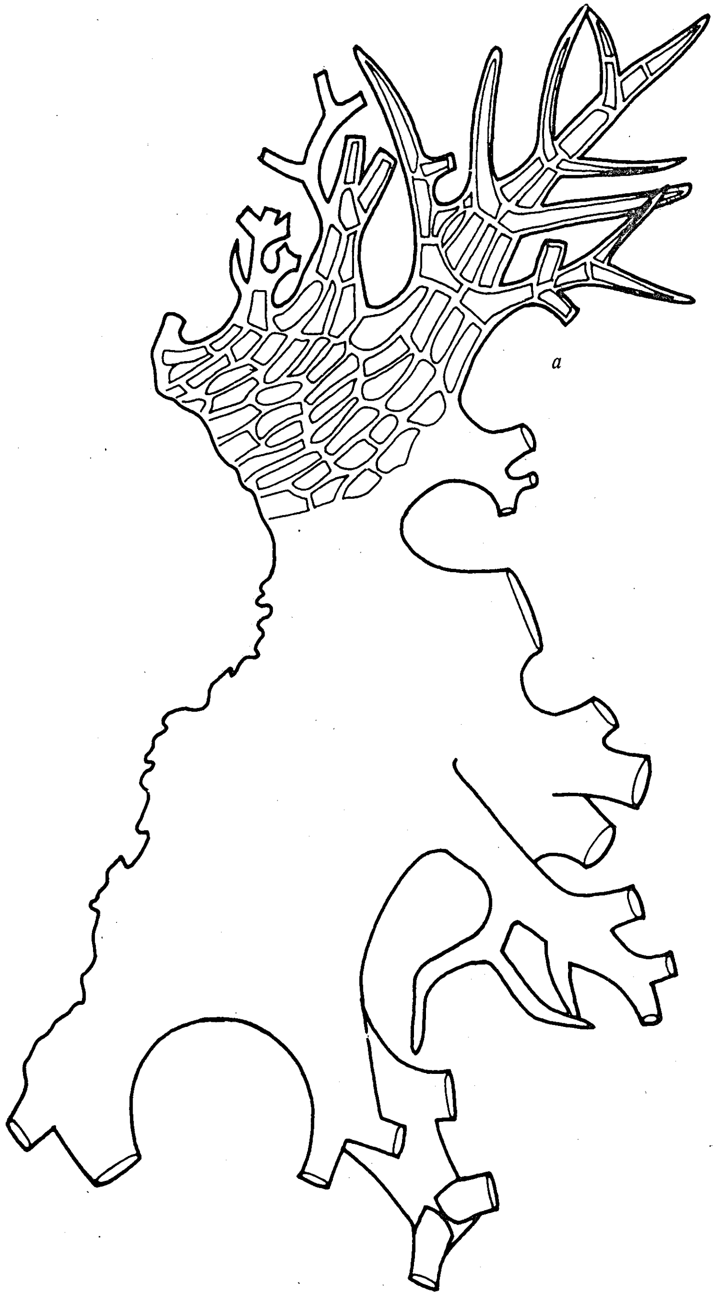

FIG. 28. *Trichocolea breviseta: a.* leaf, x 70.

Plants small to rather robust, 0.8 to 3.2 mm wide, suberect. Stems sparingly and irregularly branched; branches variable in origin. Stems rather slender and delicate, not paraphyllose, in cross section of nearly uniform cells. Leaves slightly or moderately to strongly incubously inserted, rarely transverse, quadrifid, lobes 2 to 10 cells wide at base or more, with margins and sinus not or distinctly reflexed, margins more or less toothed to prominently ciliate; cilia of more or less elongate cells in uniseriate rows. Underleaves quadrifid as the lateral leaves, similarly toothed or ciliate, subequal or much smaller than lateral leaves, inserted by a slightly to distinctly arched line. Rhizoids not abundant, but often at base of nearly every underleaf and confined there. Cells noncollenchymatous, trigones (if any) small and ill-defined; oil bodies present, colorless, granulate; cuticle verrucose to verrucose-striolate, rarely smooth. Dioicous. Androecia initially terminal on leading axes or more or less elongate postical branches; bracts nearly leaflike, 1 to 2-androus; bracteoles like small underleaves, flat, without antheridia; antheridia short ovoid. Gynoecia terminal on leading axis; bracts similar to leaves, usually somewhat larger and narrower, bracteoles similar to bracts, free; perianth large, trigonous above, mouth copiously ciliate or dentate; capsule narrowly ovoid-ellipsoid, quite firm, bispiral; spores yellow brown, nearly smooth.

TEMNOMA SETIGERUM (Lindenb.) Schust. Fig. 29.

Jungermannia setigeria Lindenb. in G.L.N. Syn. Hep. (1844), 131.
Blepharostoma setigerum Steph., Spec. Hepat., 3 (1909), 637.
Lophozia pilifera Horik., J. Jap. Bot., 12 (1936), 20, fig. 9.
Temnoma setigerum (Lindenb.) Schust., Nova Hedwigia, 5 (1963), 35.

Plants rather slender to 4 cm long, up to 3.0 mm wide, sparingly branched; branches all of the *Frullania* type subtended by a reduced, bilobed leaf. Stem 0.23 to 0.30 mm in diameter, rather firm, slender and nearly terete. Leaves contiguous, nearly plane, very widely spreading, obtrapezoidal-reniform in outline, averaging 1 to 1.4 mm wide, 0.7 to 0.8 mm long without cilia, 2 to 2.2 mm wide, 1.2 to 1.4 mm wide with cilia, very succubously inserted and oriented, shallowly and obscurely but more or less symmetrically 4-lobed or 5-lobed (divided for 0.2 to 0.25, rarely 0.35 the length leaf, without cilia; basal undivided portion 20 to 27 cells high to the sinuses), nearly plane, sinuses not reflexed; lobes broadly triangular, each with a long stiff terminal cilium usually 8 to 10 cells long, and usually with a pair of nearly opposed, much shorter cilia along their sides, occasionally with 3 to 4 cilia per lobe; antical and postical leaf margins with additional cilia. Cells small, thick-walled, apical cells subquadrate, median cells short-rectangulate. Underleaves averaging 0.3 to 0.4 the size of leaves, reniform, similar in shape to leaves, inserted by an arcuate line, poorly defined, reniform, rhizoid initial region of small cells at base. Dioicous. Gynoecia terminal on main shoots, with 1 to 3 subfloral innovations.

MINDANAO, Davao, Mt. Apo, *Miller 10945; Pancho 3741, 9002.*

Distribution: India, Java, Philippines.

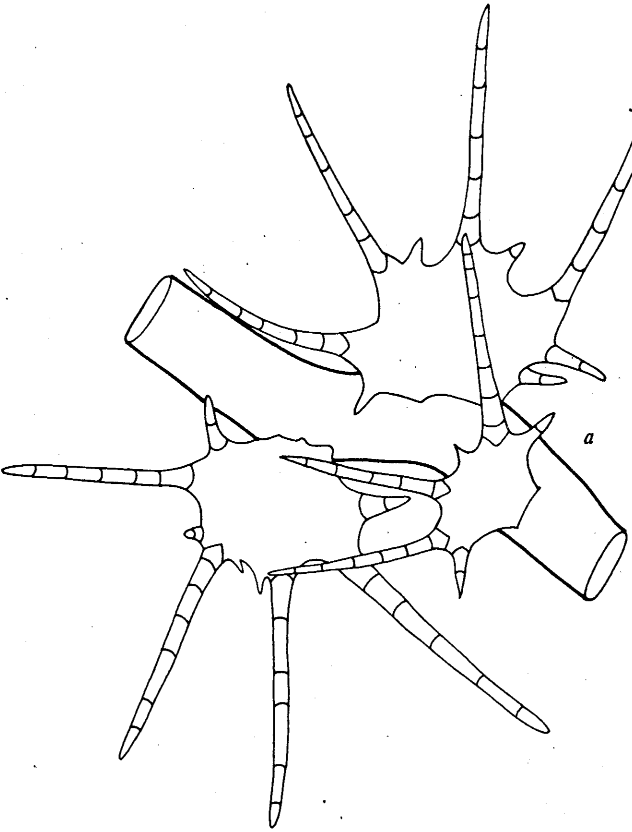

FIG. 29. *Temnoma setigerum: a.* portion of a plant, x 70.

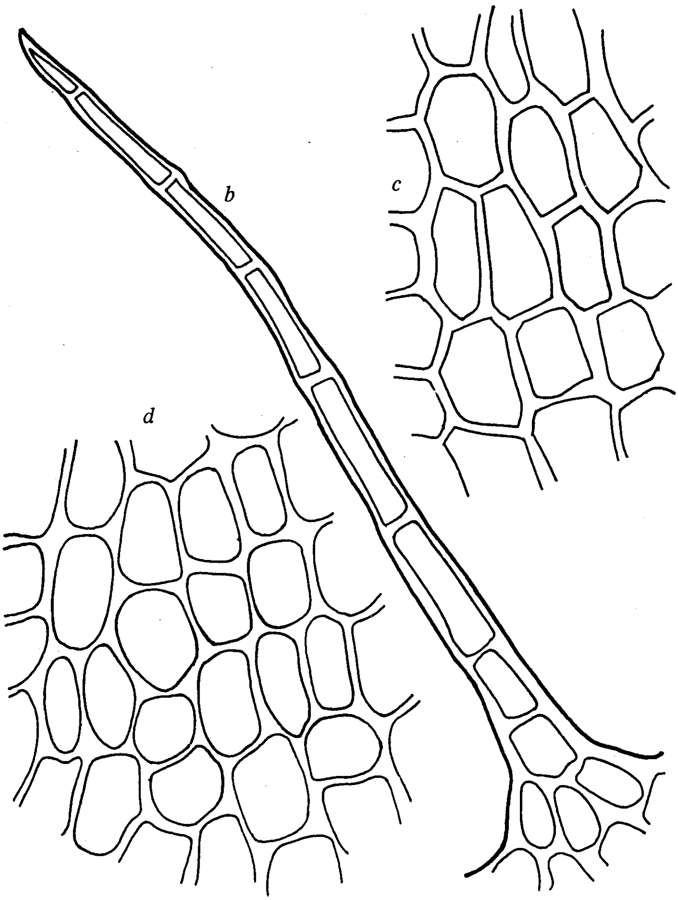

FIG. 29. *Temnoma setigerum: b.* leaf-tip, x 250; *c.* apical leaf cells, x 200; *d.* median leaf cells, x 200.

(to be continued)

REFERENCES

(1) R. M. Schuster, The Hepaticae and Anthocerotae of North America, Columbia University Press, New York and London, 1966, vol. 1, 802 p.

(2) R. M. Schuster, *J. Hattori Bot. Lab.*, **26** (1963), 185.

(3) S. Hattori and M. Mizutani, *J. Hattori Bot. Lab.*, **19** (1958), 76.

(4) E. D. Campbell, *Trans. Roy. Soc. N.Z.*, **87** (3-4) (1959), 243.

(5) R. M. Schuster, The Hepaticæ and Anthocerotae of North America, Columbia University Press, New York and London, 1967, Vol. 2, 1062 p.

(6) H. A. Miller, *J. Hattori Bot. Lab.*, **28** (1965), 299.

(7) E. B. Scott, A Monograph of the Genus *Lepicolea*, Nova Hedwigia, 1960, vol. 2, p. 1.

(8) H. Inoue, *Hikobia*, **4** (1967), 272.

(9) F. Stephani, *Spec. Hepat.*, **4** (1909), 61.

PUBLICATIONS AVAILABLE

CHECKLIST OF THE ANTS (HYMENOPTERA: FORMICIDAE) OF ASIA. By J. W. Chapman and S. R. Capco. Institute of Science and Technology Monograph I (1951) new series. Paper, 372 pages. Price, $2.00, United States currency.

NOTES ON PHILIPPINE MOSQUITOES, XVI. GENUS TRIPTEROIDES. By F. E. Baisas and Adela Ubaldo-Pagayon. Institute of Science and Technology Monograph 2 (1952) new series. Paper, 198 pages with 23 plates and four text figures Price $2.50, United States currency.

A REVISION OF THE INDO-MALAYAN FRESH-WATER FISH GENUS RASBORA. By Martin R. Brittan. Institute of Science and Technology Monograph 3 (1953) new series. Paper, 224 pages with three plates and 52 text figures. Price, $2.50, United States currency.

SECURING AQUATIC PRODUCTS IN SIATON MUNICIPALITY, NEGROS ORIENTAL PROVINCE, PHILIPPINES. By Donn V. Hart. Institute of Science and Technology Monograph 4 (1956) new series. Paper, 84 pages with 22 text figures and eight plates. Price, $1.25, United States currency.

AN ECOLOGICAL STUDY OF THE KOUPREY, NOVIBUS SAUVELI (URBAIN). By Charles H. Wharton. Institute of Science and Technology Monograph 5 (1957) new series. Paper, 111 pages with 11 plates and 16 text figures. Price, $1.25, United States currency.

FERN FLORA OF THE PHILIPPINES. By Edwin B. Copeland. Institute of Science and Technology Monograph 6, Vols. 1-3 (1958-1960) new series. Vol. 1, 191 p., Paper, Price, $1.25; Vol. 2, 193-376 p., Paper, Price, $1.75; Vol. 3, 377-577 p., Paper, Price, $1.75, United States currency.

THE PHILIPPINE PIMPLINI, POEMENIINI, RHYSSINI, NAD XORIDINI. By Clare R. Baltazar. National Institute of Science and Technology Monograph 7 (1961) new series. Paper, 120 pages with four plates. Price, $1.50, United States currency.

PACIFIC PLANT AREAS. Edited by C.G.G.J. Van Steenis. National Institute of Science and Technology Monograph 8, Vol. 1 (1963) new series. Paper, 246 pages with 26 maps. Price, $3.00, United States currency.

INDEX TO THE PHILIPPINE JOURNAL OF SCIENCE, VOL. 59 (1936) TO VOL. 79 (1950). By Angel Y. Lira. National Institute of Science and Technology Monograph 9 (1963) new series. Paper, 325 pages. Price, $3.00, United States currency.

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SHIFTING CULTIVATION AND PLOW AGRICULTURE IN TWO PAGAN GADDANG SETTLEMENTS. By Ben J. Wallace. National Institute of Science and Technology Monograph 11 (1970) new series. Paper, 117 pages with 14 text figures and five plates. Price, $1.50, United States currency.

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